Power Engineering

APRIL, 1952

Powerhouse Auxiliary Motors..... 59

Power Paces French Recovery..... 62

Filters De-Oil Feedwater..... 67

Stand-by Fuel Oil..... 72

Power Plant Floors..... 74

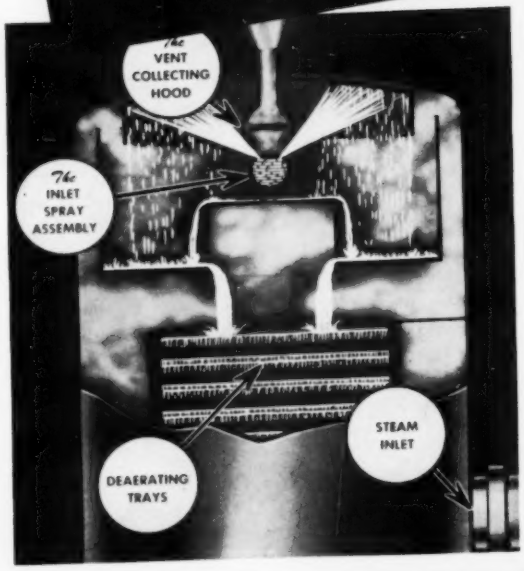
COMPLETE CONTENTS ON PAGE 5

TECHNICAL PUBLISHING COMPANY • CHICAGO, ILLINOIS

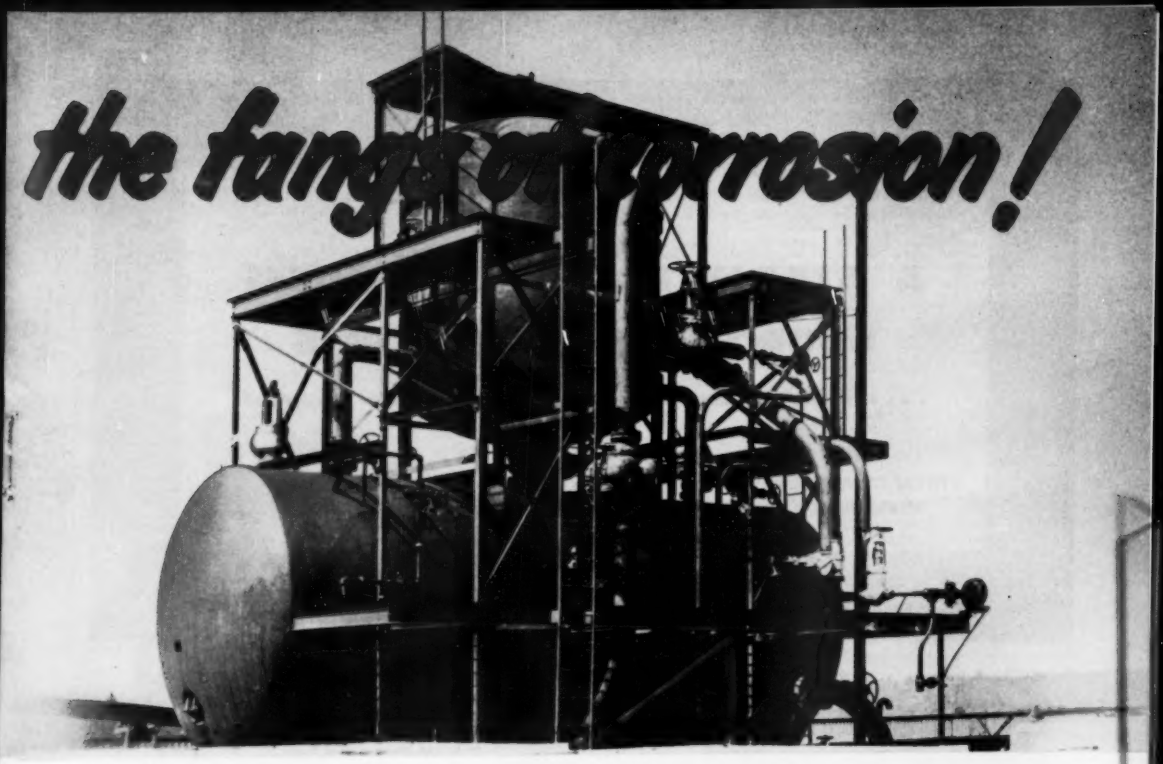
ELLIOTT
equipment for power and process

They draw

ELLIOTT
DEAERATING HEATERS



the fangs of corrosion!



Skyline views of most modern power plants

may show the Elliott deaerating heater mounted on its storage tank, as in the southern station pictured above. It is a symbol of liberty from the corrosive oxygen which it removes from boiler feedwater — a freedom which dates from the initial development of the deaeration principle by Elliott engineers.

This is the inlet spray unit and vent collecting hood, mounted inside the shell at the top. (See section drawing at left.)

The design of the Elliott deaerating heater of today virtually eliminates maintenance. The tubular vent condenser formerly used is replaced with an inlet spray unit and vent collecting hood that require no attention, and also cut down the unit's vertical dimension, important in limited headroom. Trays are of light stainless steel. Wherever undeaerated water contacts the metal, non-corrodible material is used.

The complete deaerating heater is built throughout in the Elliott shops. Full details are given in Bulletin N-16, mailed on request.

ELLIOTT Company

Deaerator and Heater Dept. • JEANNETTE, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

Q2-2

Turbochargers for Diesels

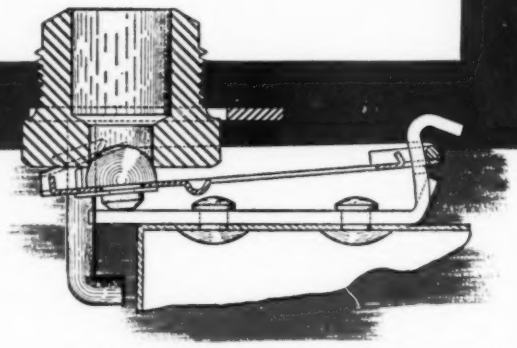
A STEAM TRAP MECHANISM GOOD FOR 900°F, 950 PSIG

. . . will last a long time on low and medium pressures

THESE ARMSTRONG USERS KNOW

"TRAPS OPERATE 4 TO 5 YEARS WITHOUT REPAIRS." . . . Weymouth Art Leather Co., South Braintree, Mass.

"50% LESS TRAP MAINTENANCE since installing Armstrongs on low pressure vacuum return heating system." . . . John Deere Ottumwa Works, Ottumwa, Iowa.



THE valve and seat in *every* Armstrong Inverted Bucket Steam Trap are chrome steel — hardened, ground and lapped to a steam-tight fit. The valve lever assembly and the bucket are corrosion resistant 18-8 stainless. You get the same design, workmanship and materials whether you order traps for a low pressure heating application or for a high pressure power plant application. *In other words, you get the longest-lasting, most trouble-free trap that money can buy at no premium in price.* If you think you'd like that, call your nearby Armstrong Representative for the traps you need now.

ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

SEE OUR CATALOG IN SWEET'S

FACTS, FIGURES, PRICES and complete data on trap sizing are contained in the 44-page STEAM TRAP BOOK. Send for your copy.

ARMSTRONG STEAM TRAPS

EDITORIAL STAFF

ANDREW W. KRAMER
Editor

CHESTER R. EARLE
Managing Editor

RECORD H. ROGERS
Associate Editor

WARREN F. SAAS
Associate Editor

MARIAN E. HENIKEN
Equipment Editor

THOMAS E. HANSON
Consulting Editor

JAMES E. WILCOX
Staff Artist

SBME Society of Business Magazine Editors

▲

TECHNICAL PUBLISHING CO.
110 S. DEARBORN ST.
CHICAGO 3, ILLINOIS

▲

KINGSLEY L. RICE, *President*
EDWIN C. PROUTY, *Exec. Vice Pres.*
WALTER PAINTER, *Vice President*
RICHARD H. MORRIS, *Editorial Director*
EDWIN C. PROUTY, JR., *Secretary*
ARTHUR L. RICE, JR., *Treasurer*
EARL R. NOREN, *Prod. Manager*
RICHARD WEIDNER, *Asst. Prod. Manager*

▲

RICHARD M. WARD
Vice President in Charge of Sales

▲

DISTRICT MANAGERS

CHICAGO: Arthur L. Rice, Jr.
John R. Morrison
110 S. Dearborn St., Chicago 3, Ill.
Phone: DEarborn 2-5446

NEW YORK: Richard Y. Fuller
Oscar Wilds
1613 Graybar Bldg., New York 17, N. Y.
Phone: Murray Hill 5-3779

PHILADELPHIA: Oscar Wilds
1235 Jericho Road, Abington, Pa.
Phone: Ogontz 7261 W

CLEVELAND: Richard M. Ward
2945 Fairmount Blvd.
Cleveland Heights, Ohio
Phone: Fairmount 1-0616

PACIFIC COAST: McDonald-Thompson
Leslie Meek, Mgr.
615 Market St.
San Francisco 5, Calif.
Phone: Yukon 6-0647
Connie J. Grabb
3727 West Sixth Street
Los Angeles 5, Calif.
Phone: Dunkirk 7-5391
Harry Abney
Terminal Sales Bldg.
Seattle 1, Wash.
Phone: Main 3860

SOUTHWEST: McDonald-Thompson
Richard C. Wipperman
1118 Odeans Drive
Dallas 11, Texas
Phone: Winfield 4911

Subscription Information — Published Monthly. Price: United States and Possessions $10, Canada $11, one year. Other countries $12. . . . . Single copies $1.00.

Indexed in the Industrial Arts Index and the Engineering Index on file in Public Libraries.

ECA

Acceptance under Section 34.64 P. L. & R., authorized. Publication office, Concord, N. H.

Copyright, 1952 by Technical Publishing Co.

Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

This magazine was established in 1896 as Practical Engineer. The title was changed to POWER PLANT ENGINEERING in 1918, to POWER GENERATION in 1948, and to POWER ENGINEERING in May, 1950. Rights reserved to above titles

April, 1952

VOLUME 56 — NUMBER 4

●

CONTENTS

New Recovery Boiler Features Wet-Bottom Precipitator 56

By Harry W. Vance

To paper mill men, the recovery boiler itself is not new, although not all paper mills are equipped with them and they must be used under just the right conditions. However, here is a new recovery boiler installation with a new feature — the wet-bottom electrostatic precipitator. This is a new development, used for the first time in a paper mill. Also, the use of steam air heaters in this plant is unusual, but the article shows why they were desirable

How to Select and Install Powerhouse Auxiliary Motors 59

By R. W. Ferguson

If anybody tells you that a large public utility station can be one of its own best customers for the application of electric motors, does that surprise you? Well, in this article, you will learn that there can be as many as 700 different motors in a big power plant, some of very large size. This doesn't include all the little fractional horsepower motors included in clocks, recorders and instruments. You'll also learn something about all the different jobs done by motors in a big power plant and how to pick the right motor for each job

Power Construction Paces French Recovery 62

By George A. Whetstone

Behind the news of political difficulties in France lies a very solid achievement in physical reconstruction and recovery. Among other things, a most ambitious and far-reaching power development program forms the base on which many plans are being laid. This article gives details of the building of this base, especially in hydro power, showing the building blocks under construction and being planned. This program has increased France's power production from 9,000,000,000 kwh in 1945 to 39,000,000,000 kwh in 1951

Chicago Theater Tells Story of Electricity 66

Filters Will De-Oil Your Boiler Feedwater 67

By George S. Emmerson

This is the second of four articles going into every detail of the problem of oil in condensate and feedwater. An article in the February issue reviewed the origin of the problem, discussed influence of oil in feedwater on boilers and prime movers and discussed general preventive measures. The present article describes in detail the construction and use of the filters available for de-oiling water

The Practical Engineer and Electrician Section. Contents 71

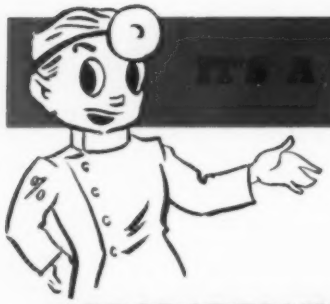
World's Largest Turbine Pumps Relieve New York City Drought Danger 88

Plans for 1952 Centennial of Engineering at Chicago 90

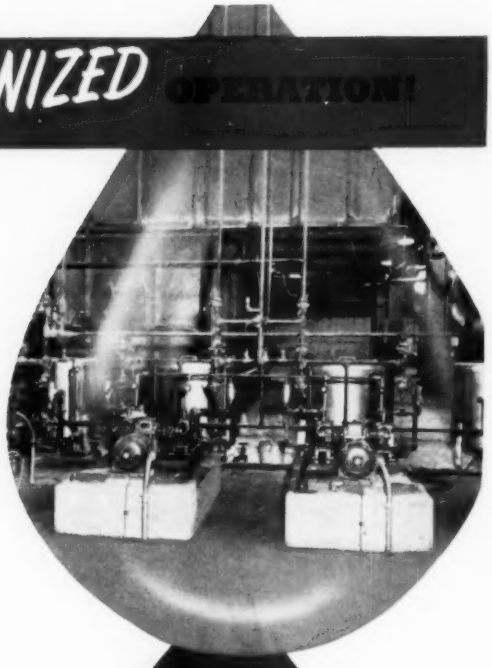
Regular Departments

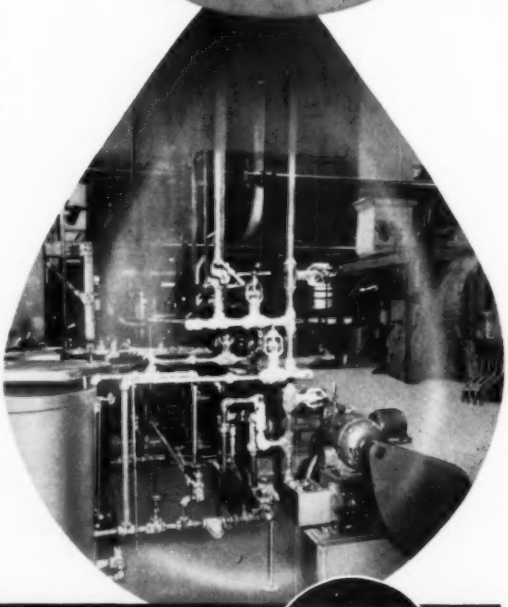
Engineers' Preview 7 — Helpful Bulletins 37 — New Equipment News 42 — Catalog Library 48 — Construction News 50 — Letters to the Editors 55 — New Engineering Books 122

The only magazine devoted exclusively to the engineering interests and practical problems of power engineers



IT'S A MECHANIZED OPERATION!





%PROPORTIONEERS%

Boiler Water Conditioning System is Positive Protection for the Boiler

%Proportioneers% installations automatically provide correct boiler water conditions, adding the proper treating chemical in proportion to demand. %Proportioneers% chemical treating systems reduce boiler maintenance, minimize operator responsibility and provide positive control of chemical application. Shown here is a %Proportioneers% installation at the Georgia Power Company's 300,000-kilowatt generating station near Newnan, Ga.

We can supply either *constant rate* or *flow responsive* chemical feeding systems for every type of power plant from the largest high pressure installation to the smallest low pressure job. These systems include metering pumps, control panels, timers, feeding and flushing valves, chemical tanks, dissolvers and auxiliary equipment such as flow meters incidental to automatic control of chemical treatment. Let %Proportioneers, Inc.% assume full responsibility for your complete chemical feeding system. Write for Brochure SM-9020 and Bulletin CAT.

% PROPORTIONEERS, INC. %

Write to %Proportioneers, Inc.%, 385 Harris Avenue, Providence 1, R. I. Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

ENGINEERS' PREVIEW

At Chicago on March 4, the U. K. Conservation of Fuel, Heat and Energy Specialist Team No. 17, in course of U. S. tour visiting leading power plants to study fuel and heat use practices, met with group of leading Chicago area power engineers

Left to right, standing: Geo. B. Burke, Sarco, Inc.; E. F. Hanford, Lever Bros.; James H. Harris, I.C.I., Ltd., Eng.; R. H. Rogers, *Power Engineering*; W. A. Wordley, Bradford Dyers' Assoc. Ltd., Eng.; H. E. Hyatt, Wm. Hollins & Co., Ltd., Eng.; Warren F. Saas, *Power Engineering*; W. S. Hudson, Dept. of Scientific & Ind. Res., Eng.; A. W. Kramer, *Power Engineering*; C. H. Marks, Republic Coal Co.; A. J. Doly, Carroll, Bechtel & Langtry; E. G. Ritchie, B.C.U.R.A., Eng.; P. T. Woodnorth, The Sherwin-Williams Co.; J. E. Koch, Union Station Steam Co.; Ed. O'Gara, Combustion-Engineering Superheater, Inc.; Albert Milnes, Sarco Co., Inc.; C. R. Earle, *Power Engineering*. Seated 2nd row: Don Brown, Corn Products Refining Co.; W. L. Lundy, Kimberly-Clark Corp.; R. H. Brennan, Albert E. Reed & Co., Eng.; W. L. Boon, Powell Duffryn Tech. Serv., Ltd., Eng.; K. L. Rice, publisher, *Power Engineering*; L. C. Watts, J. Roger Preston & Partners, Eng.; H. E. Partridge, Partridge & Earp, Eng. Seated front row: J. W. Wray, International Combustion, Ltd., Eng.; C. E. Morrow, Western Electric Co.; V. A. DeYoung, MSA; F. W. Thomas, B.C.I.R.A.; J. Hall, IND Coope & Allsopp, Ltd.

★ ★ ★

CLOUD FINDERS can be very useful to electric power utility companies for spotting distant rain clouds and thus helping predict sudden storms, which affect maintenance and operation of equipment, as well as demands of customers, which in turn affect the operation of power generating equipment. Such cloud finders may soon be used by Commonwealth Edison Co. and Public Service Co. of Northern Illinois, co-operating with the Chicago office of the United States Weather Bureau. The accompanying photograph shows an experimental model of radar equipment built from war surplus material, soon to be tested at the Municipal Airport in Chicago for locating moisture laden clouds as far away as 60 miles. Preliminary tests show that the equipment does not interfere with plane-to-tower communications and blind landing radar system at the airport. The device does not reflect any signal from ordinary clouds that do not bear rain.

This radar equipment has been adapted to aid weather forecasters in locating distant rain clouds

★ ★ ★

ALL-PURPOSE electric insulating varnish 9700 has been developed by GE's Chemical Division, suggested for treating motor and generator cores and windings, magnet coils, and transformer windings. It can be used on rotors with speeds up to 10,000 rpm. This GE 9700 may be applied by dipping, roller coating, brushing or spraying, and vacuum or pressure impregnation may be employed.

EARL C. PAYNE and Henry F. Hebley have been elected Fellows of the American Society of Mechanical Engineers in recognition of outstanding achievement. Mr. Hebley has been honored for his work in atmospheric and stream pollution. Mr. Payne was honored for his

(Continued on page 8)

MICROFILM EDITION of POWER ENGINEERING, Volume 55, for 1951, is now available from University Microfilms, 313 North First Street, Ann Arbor, Michigan. Price is $4.55 plus postage. This film, reproducing completely the 12 issues of 1951, January to December inclusive, may be obtained by companies and individuals on our circulation list. Send your orders direct to University Microfilms, not to us.

Dr. A. A. Potter presides over annual meeting of Bituminous Coal Research, February 28, Chicago. Dr. H. J. Rose, BCR's vice president and director of research, is seated

EXECUTIVES of the coal, railroad and allied industries supporting the program of Bituminous Coal Research, Inc., met February 28 in Chicago to learn of coal research progress and to chart a course for future research and development leading to increased coal markets.

Progress was reported on projects leading to the development of a coal-fired gas turbine for locomotive use, new continuous mining machines, and improved equipment for coal utilization. Exhibits supplemented the progress reports in showing research advancements in residential heating equipment, coal-fired gas turbines, stainless steel belts for conveying coal, equipment for drying agricultural products, smoke abatement devices, and non-fuel uses of coal.

During the business meeting of sponsoring companies, the members authorized the BCR directors and staff to proceed with plans for an enlarged research and development program to expand coal sales, approved suggestions of the Plan of Action Committee for an expanded research program, and asked the Board to set in motion the recommended effort to obtain the support of a minimum of 150,000,000 tons of annual production for the new program at increased membership rates.

Officers of Bituminous Coal Research, Inc., elected were: A. A. Potter, president; H. J. Rose, vice president and director of research; R. H. Sherwood, first vice president; R. E. Salvati, vice president; C. A. Reed, secretary; M. L. Garvey, treasurer, and J. F. Hanley, assistant secretary-treasurer.

---

contributions to fuel performance and for outstanding work in organizing and directing group programs to advance the art and profession of fuel engineering.

★ ★ ★

GREAT BRITAIN, which is trying to overcome a huge electric power deficit that is hampering defense output, shortly will get some technical help from 17 American power and utilities experts. The group, consisting of technicians, engineers, and labor and management representatives, will visit British power plants on a six-week tour sponsored by the Mutual Security Agency and the Anglo-American Council on Productivity. The experts are on loan to MSA from their companies without cost; their expenses in Europe will be met by the British electrical industry, and the British Government and MSA will pay transportation costs. The Americans will be guests of the British Electricity Authority and will discuss recommendations that a British electrical team made to its industry after visiting the United States in 1949.

★ ★ ★

FOR MAKING quick, inexpensive copies of documents, in less than a minute, a new but still experimental photographic system was described recently by Dr. Cyril J. Staud, Director of Kodak Research Laboratory, before the Rochester Technical Section of the Photographic Society of America. The new method may eventually have wide application in business and engineering offices where a simple, speedy means of making a relatively small number of accurate copies of an original document is required. Equipment is small and compact, only slightly larger than a standard typewriter, and the demonstration of it was carried out under average room lighting conditions.

A matrix, coated with a special photographic emulsion, is exposed to bright light with a document to be reproduced and a photogelatin image containing a dark dye is transferred to the matrix. When this master image is placed in contact with a sheet of plain white paper, a thin layer of dyed gelatin is transferred to the print paper.

Now don't immediately swamp us with letters asking where you can get one of these machines, for Dr. Staud emphasizes that the system is still very much in the research development stage and may require a year or so of testing and development work before it can be made available. However, the idea would seem to have so many applications in engineering work that it is worth following. Keep in touch with it through Dr. Staud of the Kodak Research Laboratory at Rochester, N. Y.

★ ★ ★

C. FREEMAN HAWLEY, has been promoted from assistant chief mechanical engineer to chief mechanical engineer of Riley Stoker Corp. Mr. Hawley joined Riley after he was graduated from Worcester Polytechnic Institute in 1923. In 1924 he was lent to the Test Department of Public Service Co. of New Jersey and later he was design and service engineer associated with development of pulverized coal equipment for Riley Stoker Corp. until 1932. Since that time he has been assistant chief mechanical engineer in charge of pre-sale engineering of steam generating equipment, until his present promotion. He is a member of the ASME, a registered professional engineer, and a member of NSPE.

L. Dudley Bruce has been promoted to chief project engineer of Riley Stoker Corp. He went to Riley in 1928, then spent three years with the B & W Contract Engineering Department; returned to Riley in 1933 as design engineer of fuel-burning equipment, project engineer 1936 to 1947, and supervising mechanical engineer until the present time. He is a registered professional engineer in the State of Massachusetts.

★ ★ ★

SWILL to humans is swell to pigs. But they are in for a hard squeeze because of the softer home-making life of humans — the canned and frozen foods and the garbage grinders in the kitchens, all of which decrease the quantity and quality of refuse — otherwise garbage, otherwise swill — most of which is supplied to pig farms. So reported Carl Schneider, Consulting Engineer of the New Orleans Department of Public Sanitation, before the ASCE convention. He says it materially affects garbage disposal problems.

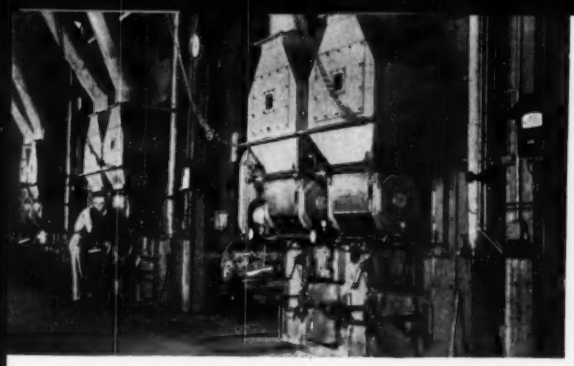
★ ★ ★

THERE HAS BEEN much agitation on the West Coast about methods of getting fresh water from the Pacific Ocean water as a possible means of relieving some of the drought areas. One recent plan for vacuum distillation that has been proposed to solve this problem was discussed at some length in POWER ENGINEERING last year.

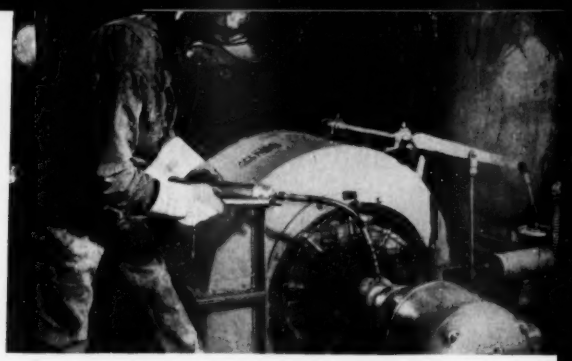
Another plan recently proposed would be to use a giant still, the heat for which would be supplied by going down into the earth about 15,000 ft, with some sort of heat transfer fluid and letting the earth's heat raise its temperature so it could be pumped up for use in the still.

However, according to March 1 *Business Week*, a much more practical and economical plan has just been announced by Ionics, Inc.: a process in which sea water flows through membranes or filters charged with electricity. The charges on the membranes swap places with the charges of the salt carried in the water, thus the salt and water are separated. Two-thirds of the water would come out nearly pure and the other third would carry away the salt in the form of brine. It is claimed that the equipment could be mass produced for prices that would keep processing costs between 10 and 20

(Continued on page 116)



TO GENERATE STEAM for manufacturing, Triangle Conduit and Cable uses three 350 hp boilers. Each unit generates 22,500 pounds per hour, 24 hours a day, 5 days a week. *Sun Solnus Oil* lubricates the spreader stoker oil bath, *Sun 844 Grease* the pulley drive, stoker motor and pillow block.



TO CONTROL THE AMOUNT OF AIR entering the fire box, three forced draft fans are kept in constant operation. The motor and fan bearings and the speed reducer motor are lubricated with *Sun 844 Grease*, while the gears and reducers are protected by a *Sun* gear oil.

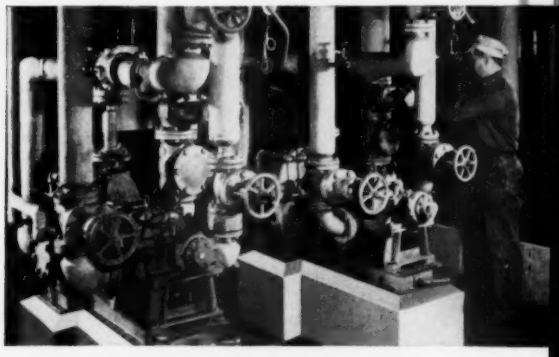
MODERN POWERHOUSE ENTIRELY SUN-LUBRICATED

Triangle Conduit and Cable produces flexible and rigid electrical conduit and cable. Its modern powerhouse generates steam for galvanizing pipe and for heating the factory, the pickling vats and the enamel paint vats prior to dipping the pipes. From the very beginning of operations more than two years ago, Sun oils and greases have been used exclusively in all the equipment, and there hasn't been a single failure because of faulty lubrication.

This modern powerhouse is wholly lubricated by Sun "Job Proved" products and the factory partly so. In both, Sun's engineering know-how has effected purchasing and inventory economies through multiple use of a minimum number of oils and greases.

For technical assistance or a copy of the manual "Lubrication of Industrial Machinery," write on your business letterhead to Department PN-9.

TO HELP GET PROPER COMBUSTION in the boilers, three exhaust fans are used. The turbine which drives them turns up 3,600 rpm. The engineer says the lubricant, *Sunvis 951*, looks like new when it is changed to get rid of condensate.



TO FEED WATER TO THE BOILERS, two 3,500 rpm turbine-driven pumps are employed. A motor-driven pump is used in starting up when there is no steam pressure. *Sunvis 951* lubricates the turbines, *Sun 844 Grease* the pump fittings.

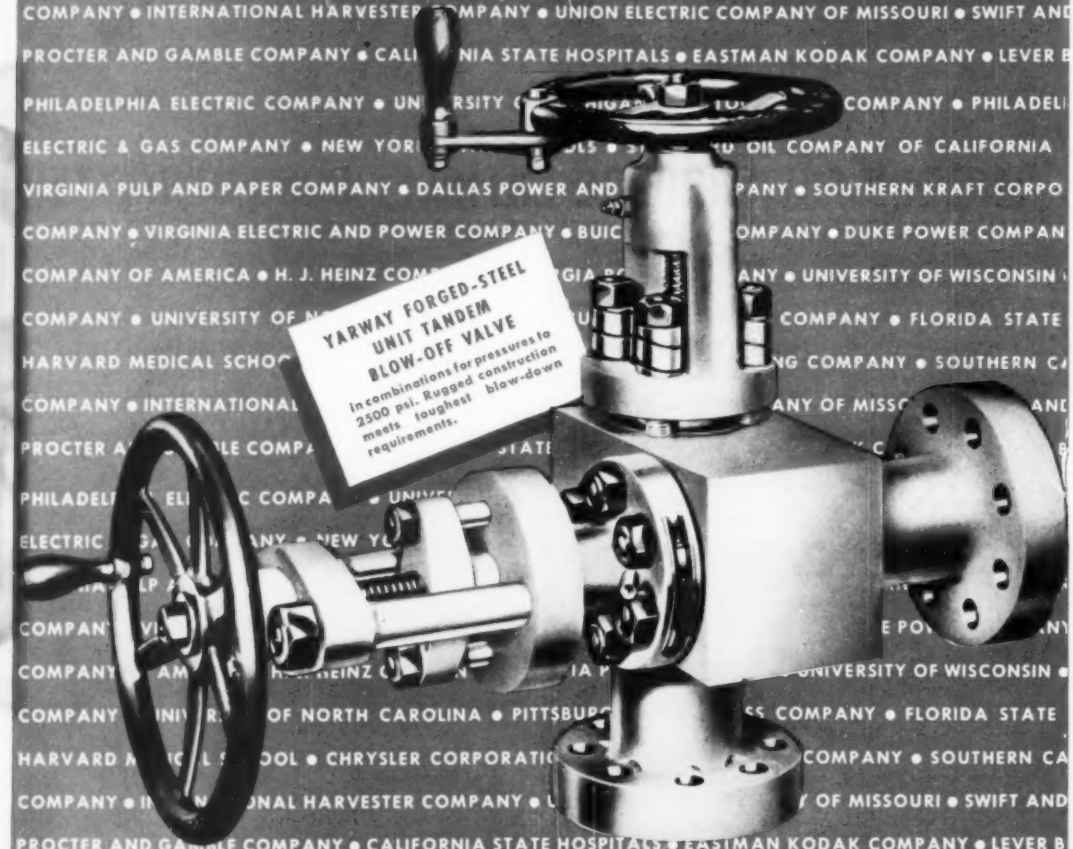
SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO®

A BLOW-

IS KNOWN BY THE


YARWAY FORGED-STEEL
UNIT TANDEM
BLOW-OFF VALVE
in combinations for pressures to 2500 psi. Rugged construction meets toughest blow-down requirements.

YARWAY

HIA PUBLIC SCHOOLS • PACIFIC GAS & ELECTRIC COMPANY • IOWA STATE COLLEGE • PUBLIC SERVICE
BOST… …AN… …LI… …APA… …UN… …/EST
RATIO… …E… …P… …ANY) …IC… …AN… …ER… • …TOR
Y • E.I. … …S … …MPANY … …AN… …LI… …IC… …NY… …IUM
R. J. REYNOLDS TOBACCO COMPANY • CARNEGIE INSTITUTE OF TECHNOLOGY • HUMBLE OIL AND REFINING
HOSP… • …M… …R… …NG… …R… …OM… …NY • …N… …SITY… …S… …ET… …H… …ST… …A… …Y •
LIFO… …E… …N… …C… …AP… …IY • …IO… …ORPO… …AT… …N OF… …MERI… …A… …I… …D… …N… …TO… …P… …VER… …AND… …GHT
COMPANY • FLORIDA POWER COMPANY • ARMOUR AND COMPANY • UNIVERSITY OF PENNSYLVANIA •

OFF VALVE

BOILERS IT PROTECTS

When buying blow-off valves, weigh the significance of these two facts:

More than 15,000 boiler plants in the United States and other countries are equipped with Yarway Blow-Off Valves . . . Some of them for nearly 40 years. *Among high pressure plants, 4 out of every 5 in the United States are Yarway-equipped.*

Design, metallurgy, workmanship and service are the reasons. It was Yarway that brought out the famous Seatless Valve, teamed it with a stellited hard-seat valve in a common forged-steel body to make the popular Unit Tandem. Yarway has also made available metallurgical improvements to withstand the chemical reactions of acid wash as well as the mechanical wear of boiler blow-down.

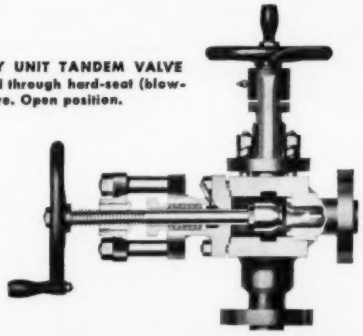
Yarway continues to pioneer and improve blow-off valves and blow-off valve service for both high and low pressure applications.

On new boilers, replacements or modernization, make sure you specify Yarway Blow-Off Valves. Any boiler manufacturer will supply them on your specification.

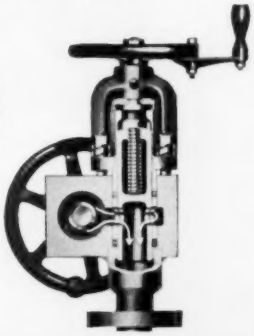
Bulletin B-424 gives you the full story on pressures to 400 psi. Bulletin B-433 for higher pressures. Both are free. Write . . .

YARNALL-WARING COMPANY, 114 Mermaid Ave., Philadelphia 18, Pa.

YARWAY UNIT TANDEM VALVE sectioned through hard-seat (blowing) valve. Open position.

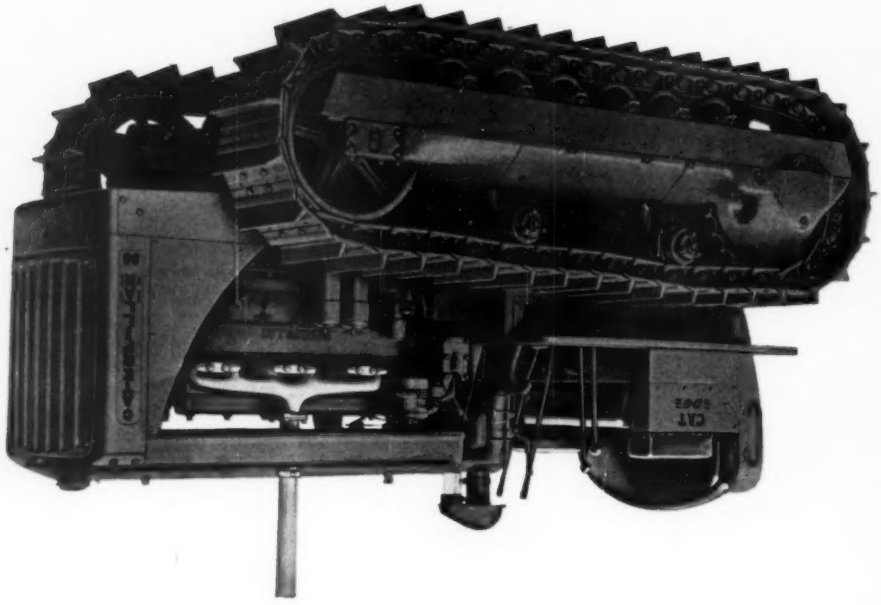


YARWAY UNIT TANDEM VALVE sectioned through seatless (sealing) valve. Open position.



WE TURNED A TRAC

to make the feeder that



WHEN CATERPILLAR TRACTOR CO., Peoria, Ill., recently installed two* Perfect Spread Stokers at its Joliet plant it had a very special reason for confidence. The same high traction principle that has been basic to Caterpillar's own success and leadership is employed in the AE conveyor feeder . . . and this principle assures 100% uniformity of spread; *absolutely prevents clogging on wet coal!*

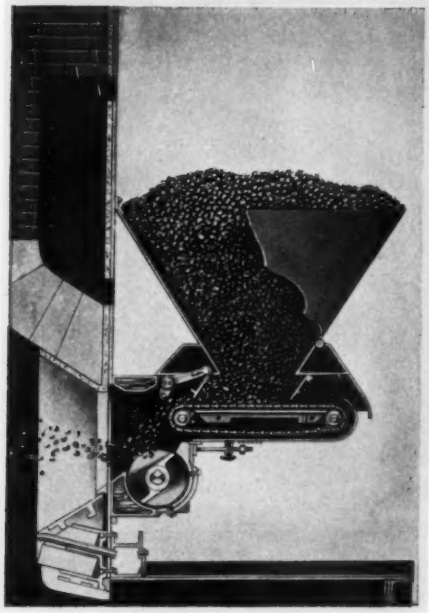
You can get Perfect Spread Stokers in a wide choice of sizes, capacities and grate types . . . but when it comes to the feeder there is only *one* choice. Every Perfect Spread Stoker is equipped with American Engineering's exclusive conveyor feeder . . . the feeder whose superiority is universally recognized and which assures true, *continuous* feeding whether operating at only 50 lbs. of coal per hour or at top capacity.

For most steam per fuel dollar, mail coupon on next page . . . today!

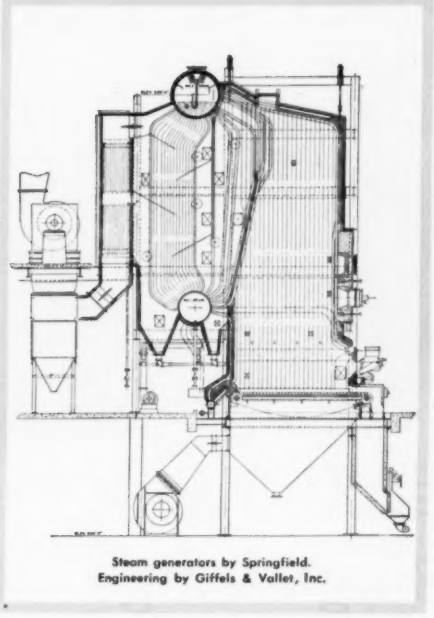
***A THIRD UNIT HAS BEEN ORDERED AND IS NOW BEING ENGINEERED.**

TOR UPSIDE DOWN

won't clog on wet coal



On Perfect Spread Stoker's traveling conveyor feeder a special mechanism drives feeder through a widely adjustable speed range – smoothly and continuously . . . Feeder unit protected against furnace temperatures by water and air cooling around furnace opening and rotor bearings . . . Special high-capacity spiral overthrow rotor distributes coal evenly over the entire grate surface . . . AE reinjection system features visible feed ejector hoppers, ejectors and nozzles of alloy iron. Complete reinjection unit serves every cinder drain point.



Steam generators by Springfield.
Engineering by Giffels & Vallet, Inc.

Cross section drawing showing arrangement of boiler components and some of the principal auxiliaries of the Perfect Spread Stoker installations at the Joliet plant of Caterpillar Tractor Co. The two boilers are designed to operate at 80,000 lbs. per hour continuously, with a peak rating of 90,000 lbs. per hour for a two-hour period. Stokers are 12' wide by 14' 3" long, center to center sprockets. Each stoker has three feeders; 171 sq. ft. total grate area with 150 sq. ft. active area; and each is operated by a 1½ hp. 1800 r.p.m. electric motor.

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Le-Hod Hoists, Le-Hod Car Pullers.

American Engineering Company
2408 Aramingo Ave., Philadelphia, Penna.

Gentlemen: – We are interested in getting top efficiency from both low and high ash coals. Please send us full information about Perfect Spread Stokers.

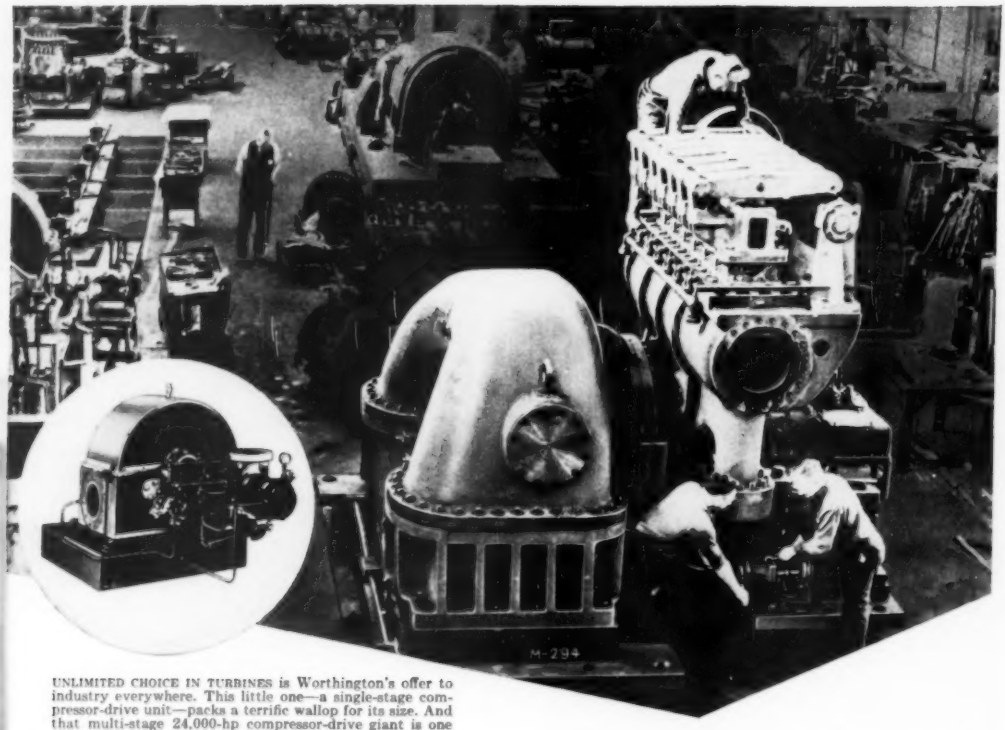
☐ Also send us complete story of *Caterpillar Installation.*

Name..... Title.....

Company .....

Address .....

City ..... Zone..... State.....



UNLIMITED CHOICE IN TURBINES is Worthington's offer to industry everywhere. This little one—a single-stage compressor-drive unit—packs a terrific wallop for its size. And that multi-stage 24,000-hp compressor-drive giant is one of the largest ever built for this type of service.

Single-stage midgets to multi-stage giants

Whether your turbine requirements call for the biggest or the smallest—straight condensing . . . straight non-condensing . . . extraction . . . mixed pressure extraction . . . low pressure . . . high back pressure . . . for mechanical or generator drive . . . with governors for constant or variable speed—*Worthington has an answer.*

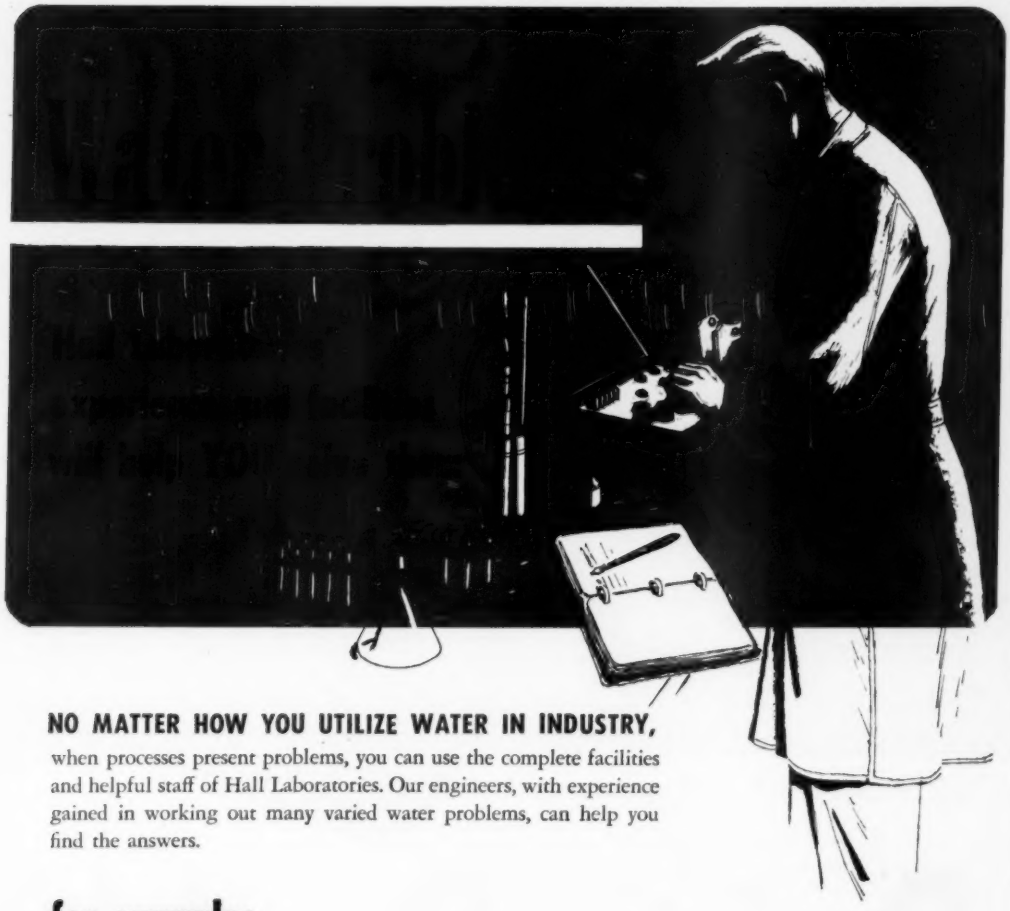
Each Worthington turbine is designed to make the steam do *more* work, so you save power and money throughout its long life.

Learn more about Worthington turbines. Get the facts on why *there's more worth in Worthington* by writing to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y. T.2.2

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbines



NO MATTER HOW YOU UTILIZE WATER IN INDUSTRY, when processes present problems, you can use the complete facilities and helpful staff of Hall Laboratories. Our engineers, with experience gained in working out many varied water problems, can help you find the answers.

for example:

SCALING and CARRYOVER in marine evaporators are troublesome. Hall has made an investigation with Bull & Roberts, Inc.* to determine how best to handle these problems in shipboard units producing distillate from fresh water and from sea water.

The combined experience of Hall engineering and research helped produce effective methods of treatment for these evaporators. One result: Five pounds of chemicals per 1,000,000 pounds of sea water fed to an evaporator worked wonders. This mixture, applied carefully and within specific operating limits, stopped scaling and reduced foam height over 90%.

For water problems of all kinds, check with Hall Laboratories. Write, call or wire Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pennsylvania.

* *Water conditioning specialists in the marine field.*

HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

HALL PLANT WIDE WATER SERVICE

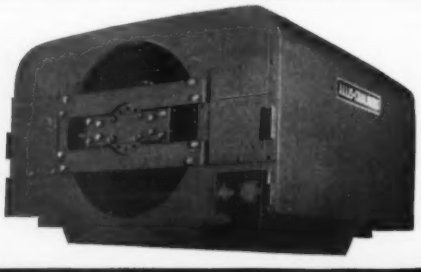
Consultants on Procurement, Treatment, Usage and Disposal of Industrial Water

WA-Series

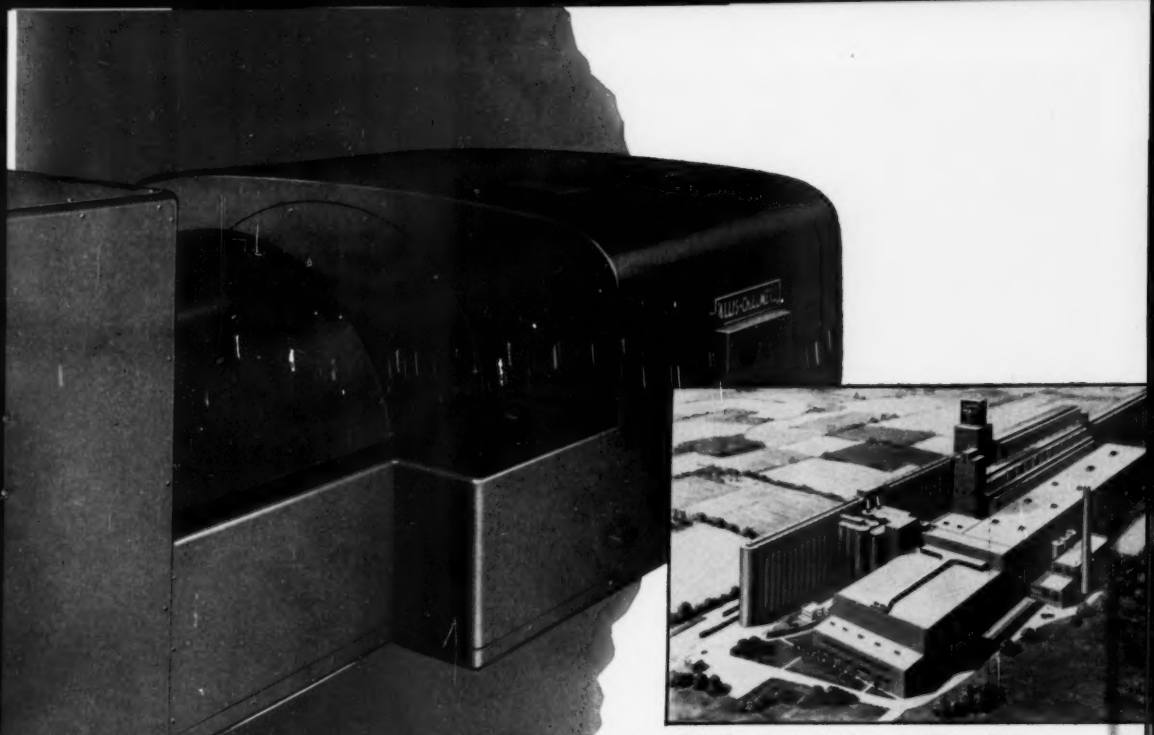
STEAM TURBINE GENERATOR UNIT

Doing Double

AT ONE OF WORLD'S LARGEST MALT



SIMPLIFYING INSTALLATION, both turbine and generator (shown at left) are shipped as complete assemblies with the rotors locked in place. The WA-Series generator is of the housing type with air-coolers mounted in the stator above the floor lines, eliminating special coolers and duct work.



Ladish Malting Co. Uses Steam for both Processing and Power Generation

Duty

HOUSES!

GREAT QUANTITIES OF STEAM are required in the process of manufacturing 10 million bushels of malt annually at the Ladish Malting Co., Jefferson Junction, Wisconsin. And, as an economic by-product, the electric power needed for plant operation is generated by the same steam.

When this world's largest single unit malt house recently needed more generating capacity, Allis-Chalmers again was chosen. And with good reason, since two Allis-Chalmers units had been supplying the electric power consumed at the Ladish Malting Company for nearly fifteen years.

Installed in 1951, the modern 2500 kw WA-Series unit shown here is now on 24 hr a day, 7 day a week duty. It consists of a non-condensing impulse steam turbine and housing type air-cooled generator and exciter . . . carefully engineered and manufactured to operate as an integrated unit.

Built for condensing or non-condensing service in NEMA ratings through 7500 kw, a modern WA-Series unit also will enable *your* power plant to meet tomorrow's expanded power demand. Complete details contained in new Bulletin 03B7654. For your copy, just call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wis.

A-3401

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Four reasons why G-E cast-in-concrete reactors outsell all others

Before choosing current-limiting reactors to protect equipment—to minimize short-circuit drop in bus voltage—or to reduce the current-interrupting duty of your breakers—take a few minutes to consider these reasons why G-E reactors are outselling all others:

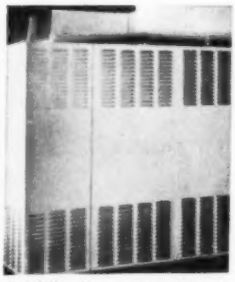
High-strength concrete supports and conductors form a one-piece structure. Special curing with wet steam under high pressure yields a concrete with several times the strength and durability of ordinary concrete.

Non-aging glass insulation offers greater protection against turn-to-turn short circuits than any other type of wound insulation used in reactor manufacture. Will not deteriorate even under high overloads. Remains unaffected by moisture.

Continually transposed conductors result in more uniform distribution of current—reduced losses and greater short-circuit strength.

Other "extra-service" features include: good clearances, elimination of through bolts, crossovers made *within* concrete supports to give maximum protection against flashover; black flameproof japan finish that provides smooth, easily-dusted surface; silver-plated terminals that insure permanently low contact resistance.

For full information on the application of sturdy, dependable cast-in-concrete reactors, get in touch with the nearest G-E Apparatus sales office. *General Electric Company, Schenectady 5, New York.*



Metal Housings can be obtained to match your switchgear. Such housings minimize stray current and electrical losses—provide additional protection against possible damage from external causes. They also mean better appearance and increased safety for personnel.

401-96

GENERAL ELECTRIC

Remember—the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Engineered to cut maintenance manhours

Scrappy says, "Aid defense—more scrap today...more steel tomorrow."

Write Dept. C-4 for free booklet on Allowable Working Pressures. Use coupon on reverse side.

CONSIDER THIS when you specify welding fittings for permanent, leakproof piping . . . the kind that's maintenance-free:

TUBE-TURN Welding Tees are drawn from seamless tubing to a barrel shape—the form every tee wants to assume under pressure. This feature, and the generous crotch radius and thickness, explain why TUBE-TURN Welding Tees withstand more pressure than required. Bursting pressures obtained in tests of representative fittings have averaged over 25% higher than required by standard codes.

For this extra quality at no extra cost get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

Be sure you see the double "tt"

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

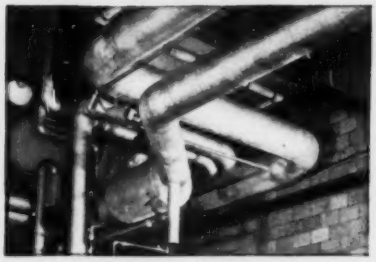
DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles
TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

Servel, Inc. specifies piping permanence with TUBE-TURN Welding Fittings

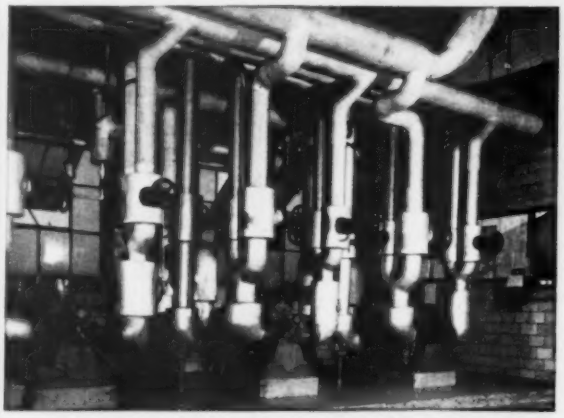
THE EXTENSIVE piping systems which serve the modern 70-acre Servel plant, in Evansville, Indiana, carry steam, condensate, air, water, acetylene, ammonia, hydrogen, oxygen, and natural gas—*efficiently.*

To avoid leakage and downtime for piping repairs, Servel engineers specify the use of TUBE-TURN Welding Fittings and Flanges for all lines 2 inches and up. Thus maintenance expense is cut to the bone. The welded system also conserves space, and provides optimum flow conditions.

Such efficiency in production services has played a large part in the growth of Servel, Inc., makers of the famous Servel gas and electric refrigerators and a variety of other products.



With no flanges to work around, insulation was easily applied to welded steam lines. Joints will not leak, and insulation will last.



These 2½", 3", 6", and 8" lines for return water pumps and water booster pumps are fabricated with TUBE-TURN Welding Fittings. Close-fitting welded piping is compact and neat.

Steel blanks for cartridge cases are washed in this tank prior to forging operation. Time was saved in tank construction by fabricating heating coils with 1½" TUBE-TURN Welding Returns. Dimensional accuracy assured perfect line-up.

Careful quality control is demonstrated by this spectrographic analysis, made of every TUBE-TURN alloy Welding Fitting before pickling, passivating, and shipping. This check, one of many, assures that user's specifications are met.

Want Pressure Data?

Tube Turns, Inc. has prepared a booklet of pressure tables covering TUBE-TURN Welding Fittings in all sizes, weights, and regularly manufactured materials for Power, Oil, Heating, Gas, and Refrigeration Piping. [illegible]

TUBE TURNS, INC., Dept. C-4
224 East Broadway, Louisville 1, Kentucky

Your Name .....
Position .....
Company .....
Nature of Business .....
Address .....
City ..... *State* .....

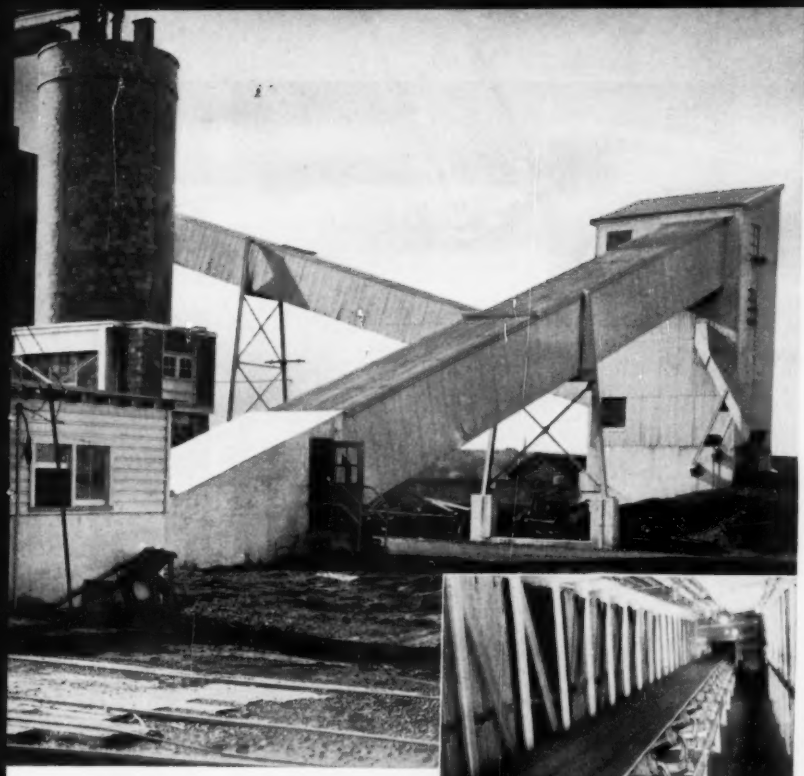
DISTRICT OFFICES

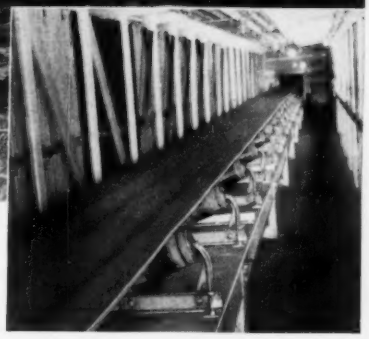
New York	Houston
Philadelphia	Tulsa
Pittsburgh	San Francisco
Chicago	Los Angeles

"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY





Starts fast at forty below...

This belt conveyor carries coal from railroad cars to overhead hoppers for a power company located in the northern part of the Midwest . . . so far north that temperatures frequently hit forty below zero. Starting the conveyor in that kind of weather meant lost time, wasted manpower. The bearing lubricant became so stiff that five or six men often were required to pull on the belt. Three hours a day frequently were lost in getting the unit in operation.

As many as a dozen conventional lubricants were tried without success before a change to STANOLITH Grease No. 42 was made on the recommendation of a Standard Oil lubrication specialist. None could match the ability of STANOLITH to provide easy starting at extreme low temperatures, and still maintain effective lubrication during high summer temperatures.

STANOLITH Greases are filling the bill in a wide range of industrial and processing applications because of their resistance to heat and to the washing action of water, and their ability to flow readily under wide variations in temperature. A Standard Oil lubrication specialist can help you take advantage of these special properties. A call to your local Standard Oil Company office is all that's necessary. Or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANOLITH
TRADE MARK
Greases

What's your problem?

Meet R. R. Rowlands, of Standard's La Crosse office. He is the lubrication specialist who worked with this power company to find the right grease for an especially tough job. And as a result of his work, the company was able to save considerable time in the operation of a coal conveyor.

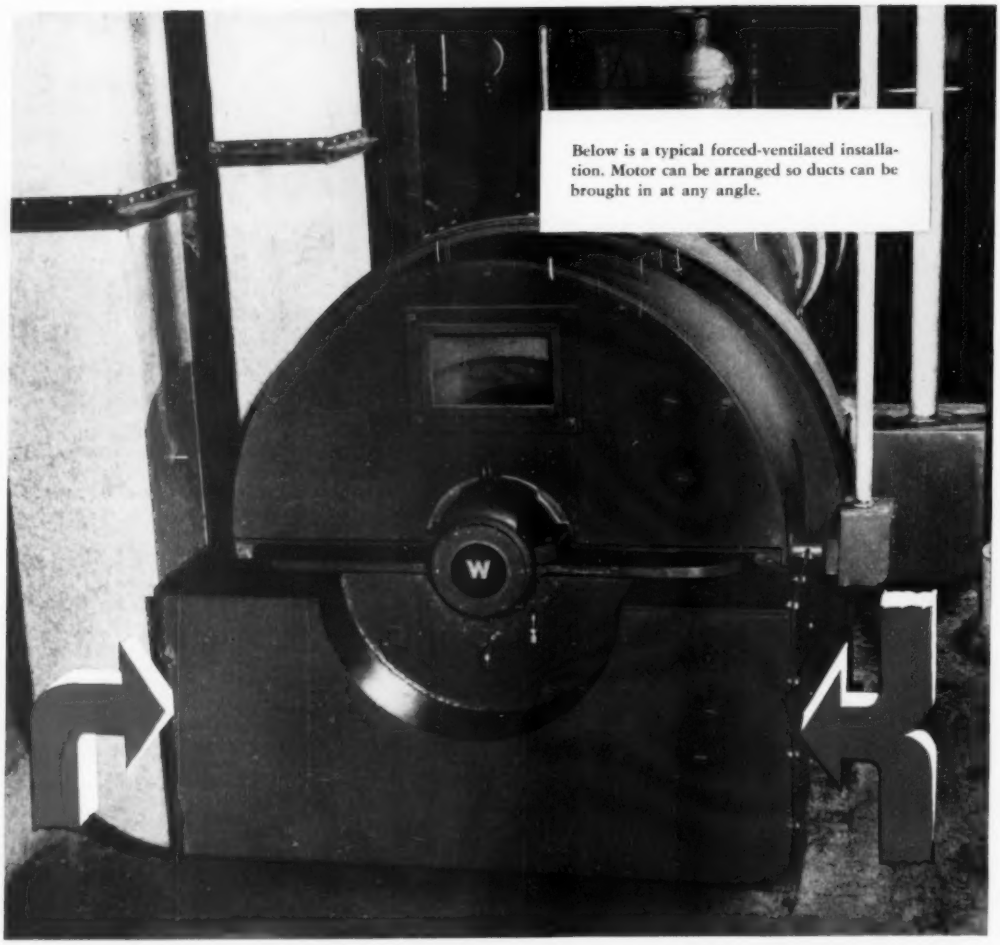
His on-the-job service is typical of that available to all midwest plants through a corps of such lubrication specialists. You can be sure that the specialist in your own area has both the practical experience and the training in a Standard Oil Lubrication Engineering School that will result in dependable, thorough assistance.

Why not call your local Standard Oil Company office today? Put a lubrication specialist to work on your problem now. When he calls, be sure to discuss the advantages and performance records of these outstanding products:

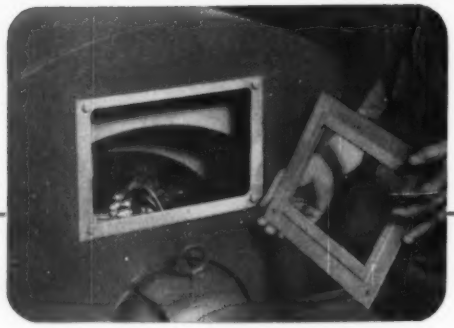
STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in air compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

CALUMET Viscous Lubricants—These greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of open gears and chains, better internal lubrication of wire ropes.

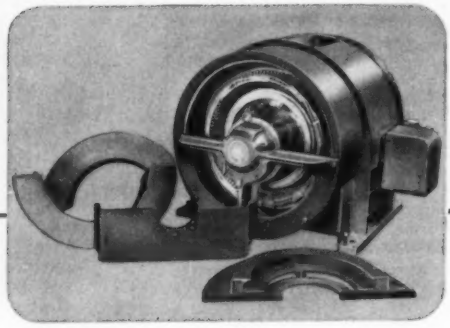
STANDARD OIL COMPANY STANDARD *(Indiana)*



Below is a typical forced-ventilated installation. Motor can be arranged so ducts can be brought in at any angle.



Lucite window makes brush inspection easy. Simply remove window for quick entrance to brushes . . . for checking and inspection and maintenance.



Light, sturdy end covers and air shields are easily and quickly removed for inspection and cleaning. No crane is required. One man can do the job easily.

MORE POWER PER DOLLAR

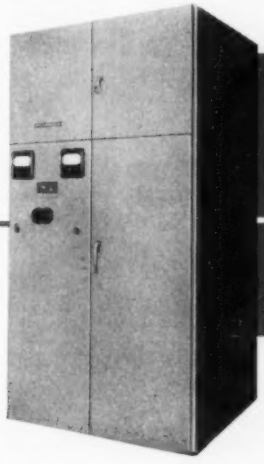
Synchronous Motor Offers New Installation Flexibility

When forced ventilation is required you can eliminate many installation problems with this synchronous motor. Air is supplied to the motor from both ends through air inlet brackets . . . two at each end, on either side. Duct or pipe connections can be brought from above . . . from below . . . from one side or the other . . . or a combination. Thus, you can position the motor without regard for duct work.

Covers and air shields, too, add to installation flexibility. They can be easily removed — by hand — for inspection or cleaning of the motor. No crane is required. Thus motors can be mounted in hard-to-reach places.

This added installation flexibility may open up new opportunities to save money with synchronous motors. In many cases, these motors will improve your power factor and reduce your power bill. They provide more power per dollar for many types of drives than any other motor.

Get all the facts on Westinghouse Synchronous Motor savings. Ask your Westinghouse representative for information on the simplified inspection and servicing these motors offer. Complete information is available. Ask him for a copy of DB-3200 or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10354



YOU CAN BE SURE... IF IT'S Westinghouse

SYNCHRONOUS MOTORS AND CONTROLS

Matched control for the motor. This Slipsyn Synchronous Motor Control protects your motor investment . . . helps you get more for your power dollar.

"Call Revere to make sure"

• Revere condenser and heat exchanger tubes and tube heads are available in a number of alloys with a comprehensive range of characteristics which adequately meet the varied requirements of service in power generation and in chemical, industrial and marine applications.

The selection of the proper alloy for a given application requires careful consideration. Many inter-related factors affect the life of a condenser tube, and have an important bearing in determining the alloy which promises the longest possible life and the most satisfactory, trouble-free performance. These important factors should be considered: chemical composition of the cooling water; velocity of the water; possibility of air entrainment; presence or absence of suspended solids; operating temperatures.

To assist the user in selecting the particular alloy which, in his specific installation should give the best service and maximum economy, the Revere Technical Advisory Service is available for consultation on both new equipment and tube replacement. These men, backed by the facilities of our Research Department, can help solve the special problems incidental to each installation. *"Call Revere to make sure."* Write for free booklet, "Life Extension for Condenser Tubes."

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

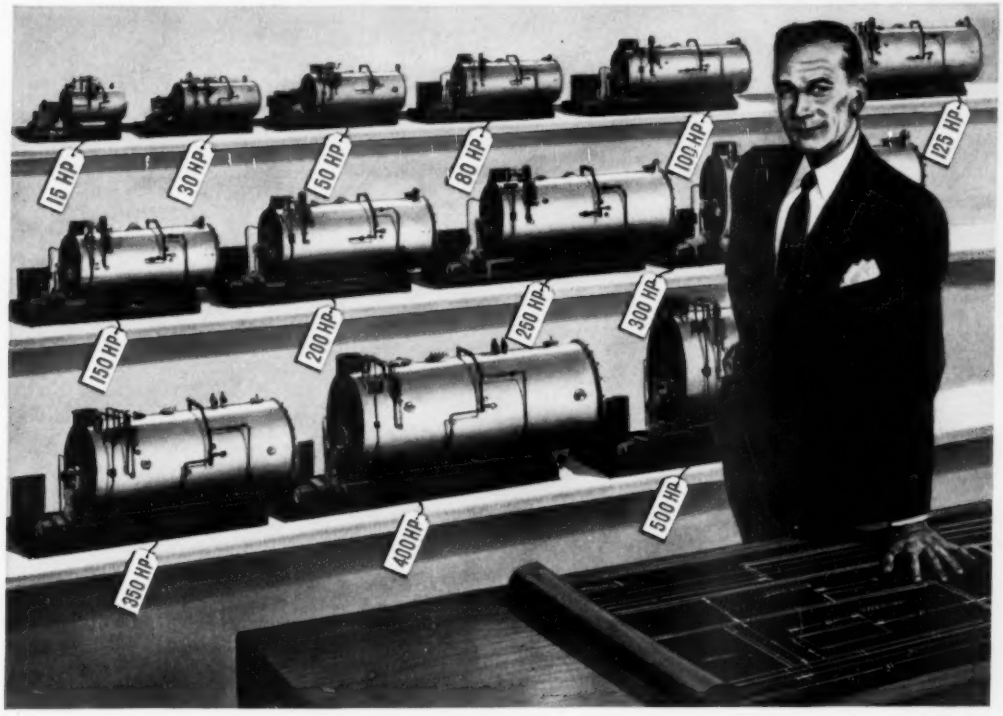
230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

Selecting The Right Boiler Is Most Important...

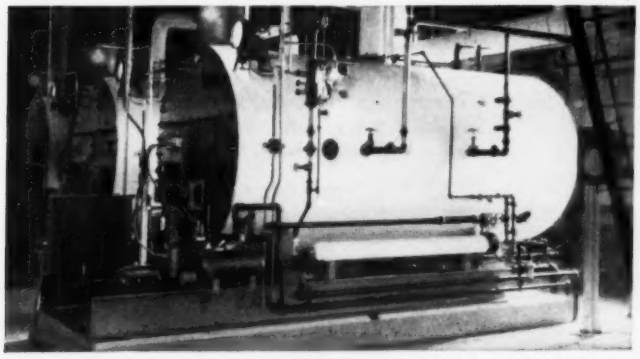


Cleaver-Brooks does not sell steam boilers "off the shelf" even though the boilers are available in standard models. Working with you, your engineers, and your consulting engineers Cleaver-Brooks helps analyze your particular steam needs and loads, both present and future.

These are a few of many factors considered: steam requirements in pounds per hour or b.h.p. — constant or fluctuating loads — fuels available — electric current characteristics — space and boiler room layout — provision for expansion.

Application engineering assistance of this kind assures you a steam plant tailored for your job. Cleaver-Brooks are the first and finest in modern, self-contained steam boilers — operate at a guaranteed efficiency of 80% — burn the fuel most available and economical in your area, gas, oil, or combination gas and oil — fully meet all codes — standard models available in sizes 15 to 500 hp; 15 to 200 p.s.i.

Write for latest, fully illustrated and descriptive Cleaver-Brooks Steam Boiler catalog.

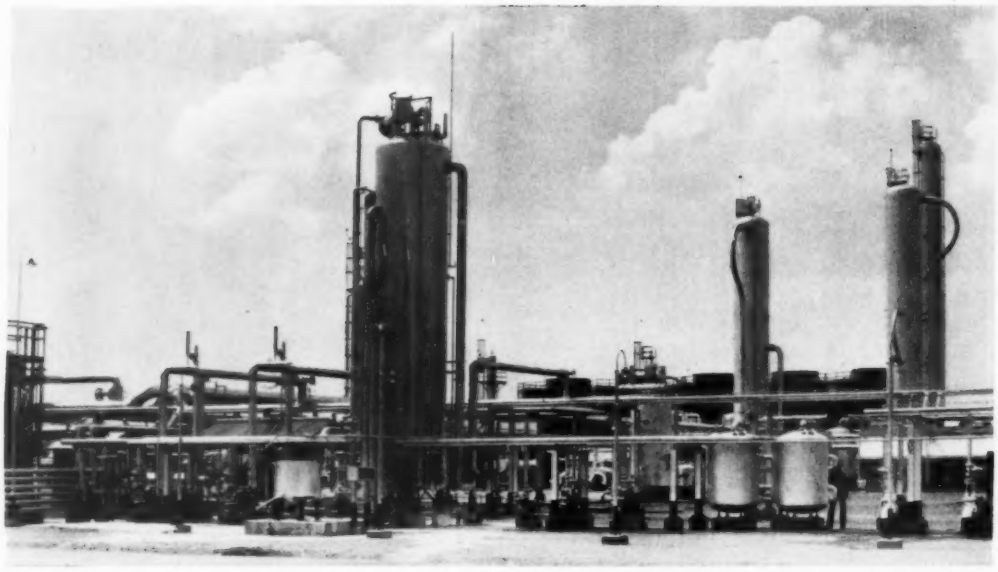


Cleaver-Brooks

STEAM BOILERS

CLEAVER-BROOKS COMPANY
Dept. D, 310 E. Keefe Ave., Milwaukee 12, Wis., U.S.A.
Cable Address: Clebro-Milwaukeewis

Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners



NORTH COWDEN GASOLINE PLANT near Odessa, Texas, operated by Stanolind Oil and Gas Company. Here Worthington Water Softeners protect boilers from scale-forming deposits.

Worthington softeners protect this plant's boilers 10 ways

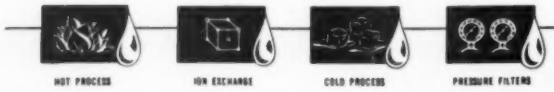
In this case, it's a hot-process softener to remove scale-forming deposits from boiler feedwater.

Let's examine this gasoline plant installation and see how it gives boilers "maximum" protection:

1. *Feed water is softened* by a hot-lime soda system.
2. *Selective deaeration* for operation on make-up only, condensate only, or both.
3. *Non-scaling direct-contact vent condenser* heats and vents treated make-up.
4. *Tubular vent condenser vents condensate.*
5. *Oxygen contamination of feedwater avoided* by last-step deaeration.
6. *Stainless steel deaerating elements.*
7. *Uniform and efficient deaeration* during wide load swings.
8. *Filter backwashing* with clean, hot, chemically inert water without velocity change through the softening zone.
9. *Proportionate sludge removal.*
10. *Uniformly proportionate chemical feed.*

Before you buy, investigate Worthington Water Softening Systems thoroughly. Tell us the service conditions, and get our recommendations in terms of dollars and benefits. We're certain you'll learn that *there's more worth in Worthington*. Write Worthington Pump and Machinery Corporation, Water Treating Section, Harrison, N. J.

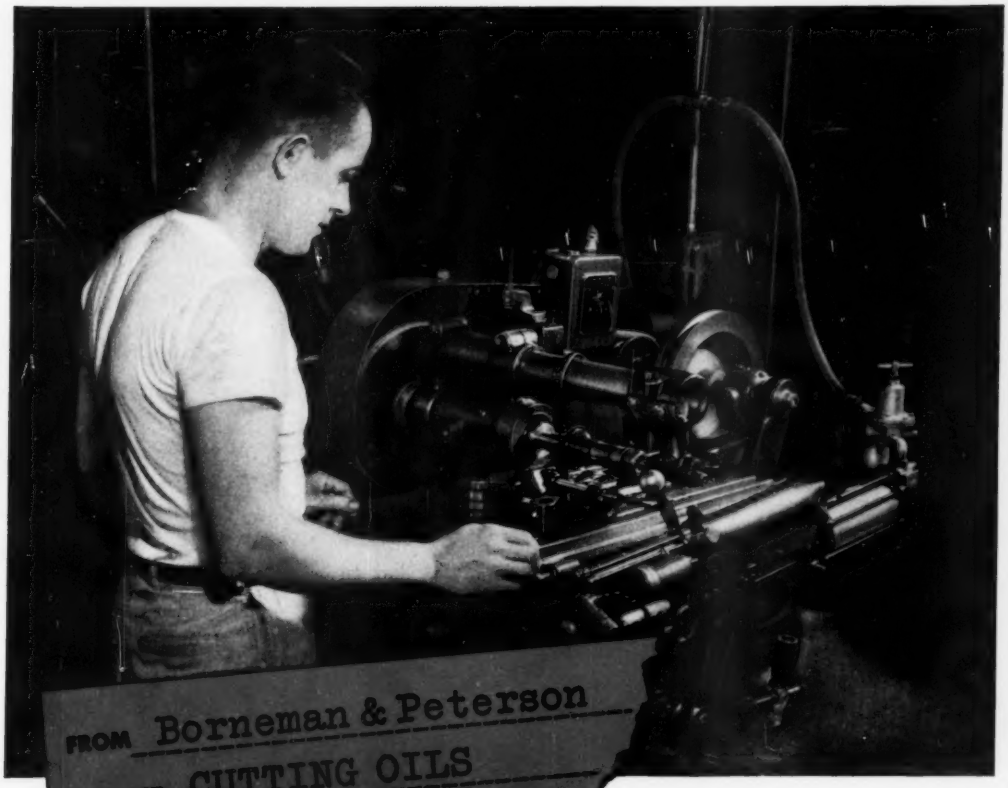
J.1.4



Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON

Water Conditioning



ANY tiny production improvement looks big when it can be multiplied by acres of machines. But even without that—in an average size screw machine products shop like Borneman & Peterson's at Flint, Michigan—the improvement effected with Cities Service cutting oil registered impressively.

"We were getting fair results," write Borneman & Peterson, "before ever talking it over with a Cities Service Lubrication Engineer."

But they did talk it over, and then tried out his recommendation on a regular job of cutting ½" x 1" slots in tough tool steel. At once, the use of Cities Service Chillo cutting oil notably improved product quality.

So..."We then tried using Chillo 10 on our threading machines, and found that not only do we get a better thread, but we have increased chaser life approximately 25%."

From there on, still more uses have kept turning up in this shop for Cities Service cutting oil, simply because it distinctly pays off...as it always does when a Cities Service Lubrication Engineer offers pinpointed lubricating recommendations. He draws on the c-o-m-p-l-e-t-e Cities Service industrial line, and on deep, wide experience. You can draw on *him* by writing CITIES SERVICE OIL COMPANY, Dept. D23, Sixty Wall Tower, New York City 5.

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

Meeting a tight

New York's largest

STEAM GENERATOR

a 1,450,000 lb per hr FOSTER WHEELER

New York is perennially "bursting at the seams"—but there is always a way to accommodate additional development. This is made possible by wise city planning and the far-sighted policy of the Consolidated Edison Company of New York, Inc. which keeps ahead of New York's ever-growing demand for electricity. The new Foster Wheeler Steam Generator now being constructed for the East River Station of the Consolidated Edison Company is a contemporary example of how one organization seeks to anticipate the needs of future populations.

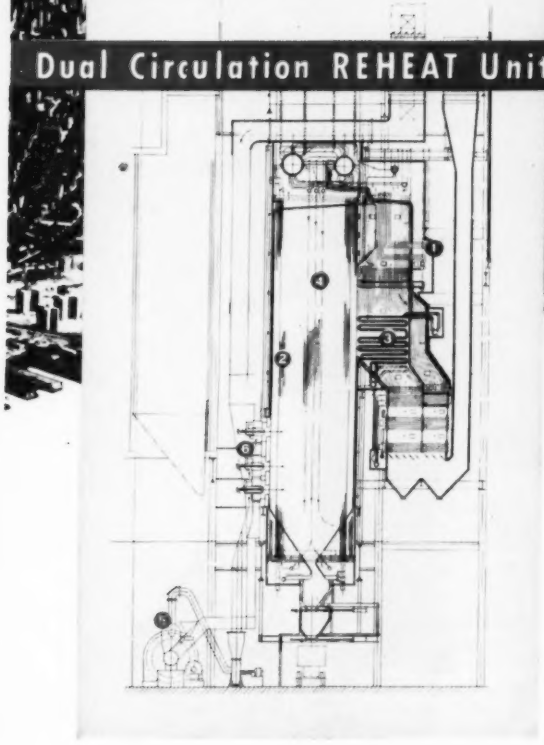
FOSTER WHEELER CORPORATION • 165

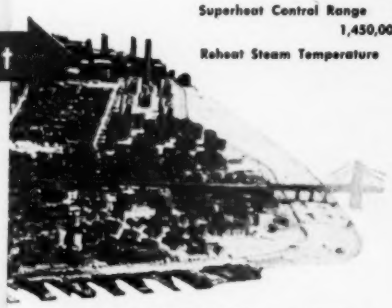
situation

New FW Steam Generator for the East River Station of the Consolidated Edison Company of New York, Inc.

Maximum Capability	1,450,000 lb per hr
Pressure Superheater Outlet	1850 psig
Primary Steam Temperature	1000 F
Superheat Control Range	325,000 to 1,450,000 lb per hr
Reheat Steam Temperature	1000 F

Dual Circulation REHEAT Unit





1. **STEAM OF SUPER PURITY**—Application of dual circulation principle produces steam of lowest contamination especially silica.
2. **RADIANT SUPERHEATER**—in combination with convection superheater enables attainment of full primary steam temperature from 25% to full load.
3. **CONVECTION REHEATER**—Location in low temperature zone after convection superheater provides protection against all variables in operation.
4. **CONSERVATIVE FURNACE**—Low heat absorption rates per unit area and low furnace exit gas temperatures.
5. **FOSTER WHEELER BALL MILLS**—High availability, low maintenance and sustained fineness of pulverization.
6. **FOSTER WHEELER TURBULENT BURNERS**—Turbulent action of air and fuel produces uniform mixture for complete combustion and even heat distribution.

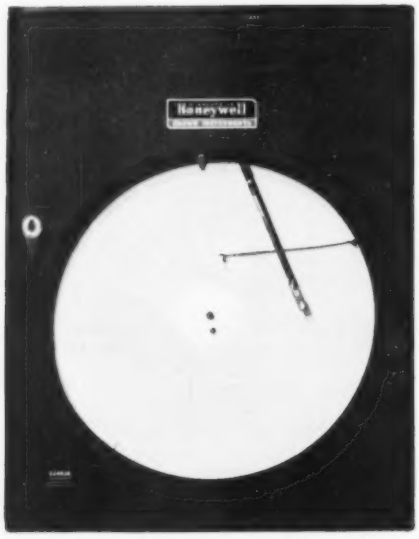
BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

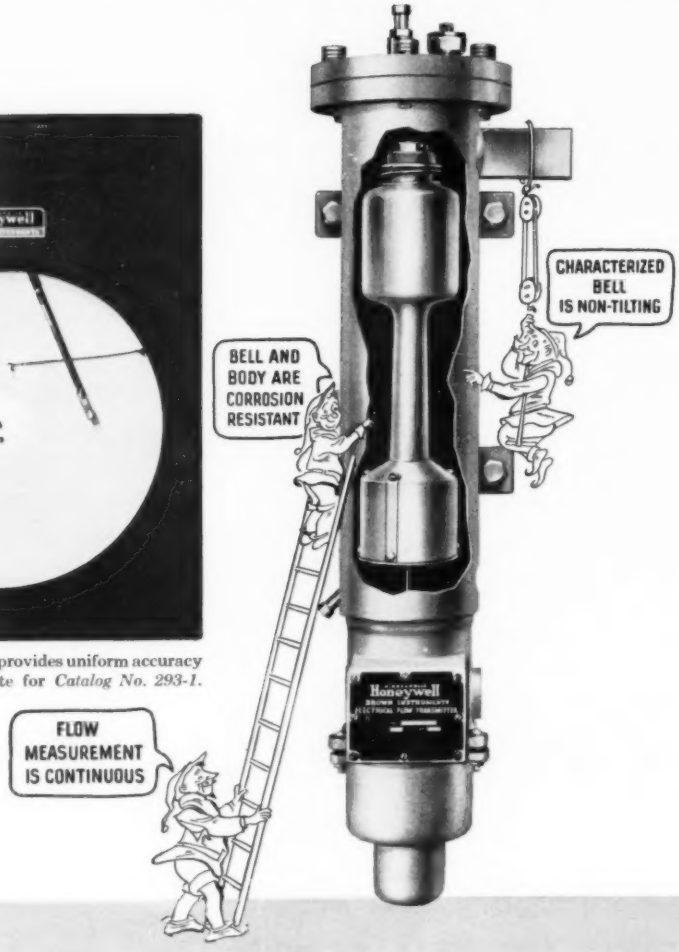
Important Contribution to

The

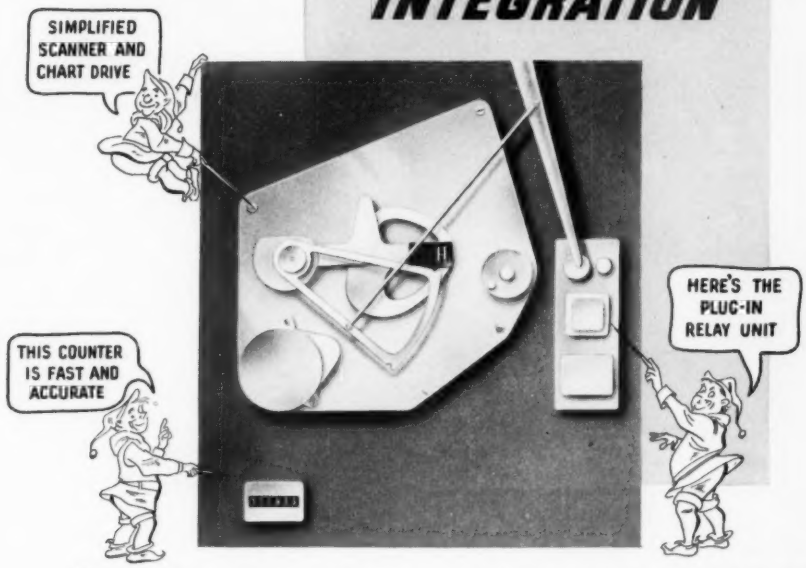
Brown Electric Flow Meter



EVENLY DIVIDED CHART... provides uniform accuracy for all rates of flow. Write for *Catalog No. 293-1.*



incorporates . . . ELECTRONIC INTEGRATION



Two important features...evenly divided chart and electronic integration... facilitate flow cost accounting; eliminate intermittent measurement and slow, complicated totalizing.

The electronic integrator, consisting of but three major parts, simplifies accessibility and maintenance . . . permits quick checking and calibration. Scanning is rapid and extremely simple. The corrosion resistant meter body is of tubular construction, reducing weight and bulk. Transmission is electric. Mechanical flow meters, evenly graduated and similar to that shown; but with the bell directly coupled to the recorder pen are also available. Recorder is fast, chart is easily read under all conditions of flow. The characterized bell is corrosion resistant, too, and is specially designed to eliminate tilting.

Call in our local engineering representative for a discussion of your application.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

● *Important Reference Data*

Write for a copy of Catalog No. 293-1, "Evenly Graduated Flow Meters" . . . and Bulletin No. 90-2, "Supervisory Instruments for Power Generation."

FREE

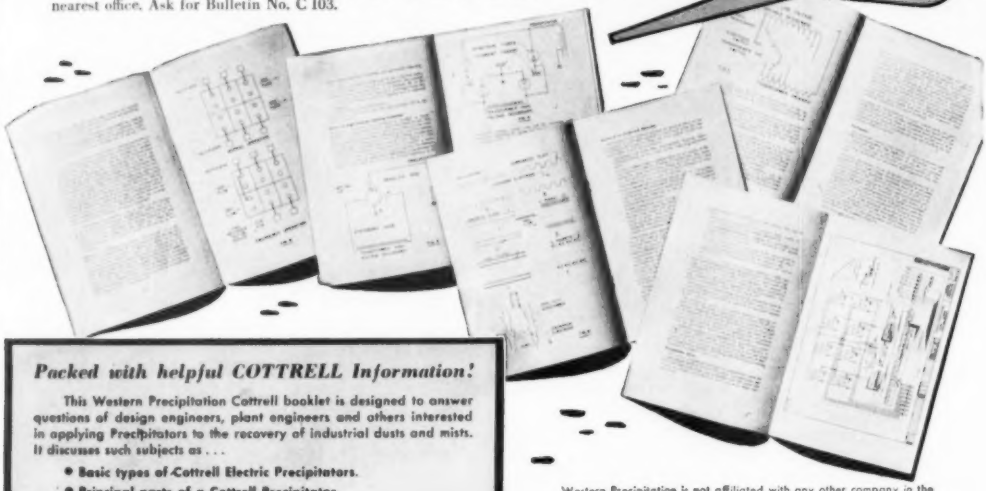
From Western Precipitation—the organization that pioneered the commercial application of Cottrell Precipitation...

IF YOU ARE ENGAGED in any phase of industry where the recovery of dusts, fumes, fly ash, mists, fogs or other suspensions from gases is a problem, you will find this booklet on the COTTRELL Electrical Precipitator helpful and informative.

Western Precipitation pioneered and installed the first commercial application of the well-known COTTRELL Electric Precipitator—Dr. Cottrell, the inventor, being a member of the company. And for more than 42 years Western Precipitation has consistently led in developing new COTTRELL advancements and techniques for recovering suspensions from gases, both wet and dry.

This 28 page booklet summarizes many of the basic facts you should know about modern COTTRELL Precipitators—the various types available, how they operate, principal types of electrode systems and rectifiers, shell constructions, etc. As long as the supply lasts, a free copy will be sent you on request to our nearest office. Ask for Bulletin No. C 103.

28 PAGES
of helpful facts to know about
COTTRELL ELECTRICAL PRECIPITATORS



Packed with helpful COTTRELL Information!

This Western Precipitation Cottrell booklet is designed to answer questions of design engineers, plant engineers and others interested in applying Precipitators to the recovery of industrial dusts and mists. It discusses such subjects as...

- Basic types of Cottrell Electric Precipitators.
- Principal parts of a Cottrell Precipitator.
- Mechanical and Electronic Rectifiers.
- Various types of Collecting Electrodes (rod curtains, corrugated plates, dual plates, pocket electrodes, etc.).
- Removal of Collected Material.
- Factors in Shell Construction (steel, concrete, brick, etc.).
- Operating Efficiencies and the Effect of Various Factors on Performance.

...and many other basic Cottrell facts. Write for your free copy of Bulletin C103 today while supplies are adequate!

Western Precipitation is not affiliated with any other company in the field of electrical precipitation except its wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. Whether you are now contemplating the installation of a Cottrell Electrical Precipitator, or may be interested in such an installation at a future date, we can and will serve you in any part of the United States or other countries.

NOW SELLING...

COTTRELL Precipitators
MULTICLONE Collectors
TURBULAIRE Spray Dryers

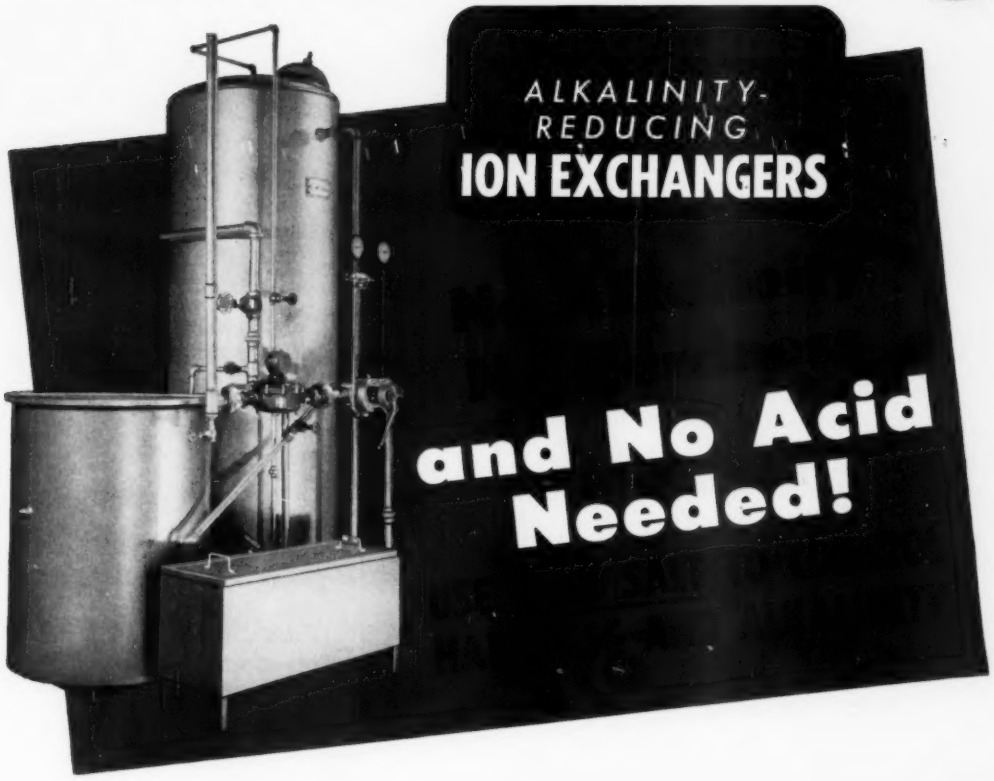
...in all parts of the U.S.A. and foreign countries.

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1029 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
CHRYSLER BLDG., NEW YORK 17 • 1 LaSALLE ST. BLDG., 1 N. La SALLE ST., CHICAGO 2 • HOBART BUILDING, SAN FRANCISCO 4, CALIFORNIA
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

Announcing



ALKALINITY-REDUCING
ION EXCHANGERS
and No Acid Needed!

THIS SALT-SPLITTER SYSTEM removes both alkalinity and hardness by means of two resin beds in one tank. Needing only inexpensive salt — no acid — for regeneration, it offers these advantages:

1. Permits operation at alkalinities approaching zero, since no acid is present to damage equipment or produce acid water.
2. Eliminates costly rubber- and lead-lined tanks and piping.
3. Simplifies disposal of spent regenerant.
4. Provides complete safety for operating personnel.

Users of sodium zeolite softeners who find them unsuitable because of the high alkalinity of the effluent or who may be by-passing raw water for boiler make-up should definitely investigate the possibilities of incorporating this system into present installations.

For a concise explanation of the operation of this new combination of two proven water-conditioning methods, get a copy of the new Allis-Chalmers bulletin, 28X7808. Just fill in and mail the coupon.

Allis-Chalmers
Milwaukee 1, Wisconsin

Please send Bulletin 28X7808 describing alkalinity reduction by ion exchange.

Name

Title

Company

Address

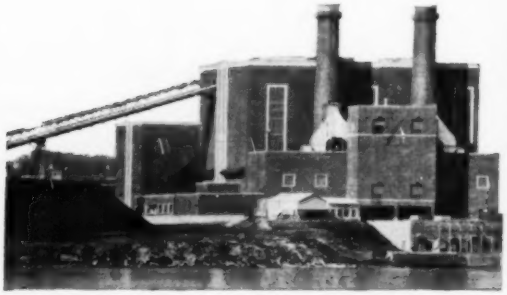
City State A-3618

ALLIS-CHALMERS

Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE

POTOMAC RIVER GENERATING STATION
Potomac Electric Power Company



In November 1951 the Federal Power Commission released a report entitled "Steam-Electric Plant Construction Cost and Annual Production Expenses for 1950."

Among other interesting and significant data were the "Average Btu per Kilowatt-hour Net Generation" of 264 power stations reporting from all sections of the country. Seven of the ten steam-electric stations having the *lowest* annual heat rates — as revealed by the report — are pictured on these pages.

All of the steam generating equipment in these seven stations was designed and built by Combustion Engineering — Superheater, Inc.

B-546

7 of

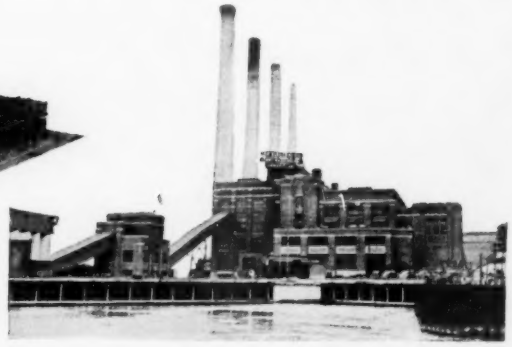
RUSSELL STATION
Rochester Gas & Electric Corporation

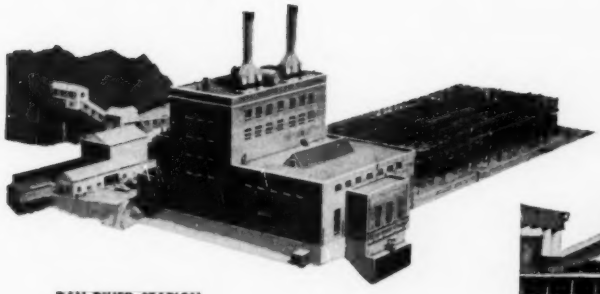
PORT JEFFERSON STATION
Long Island Lighting Company

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

PORT WASHINGTON STATION
Wisconsin Electric Power Company

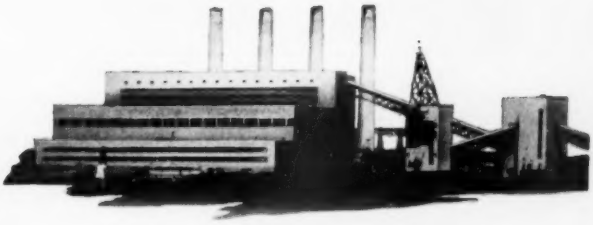




DAN RIVER STATION
Duke Power Company

the top 10

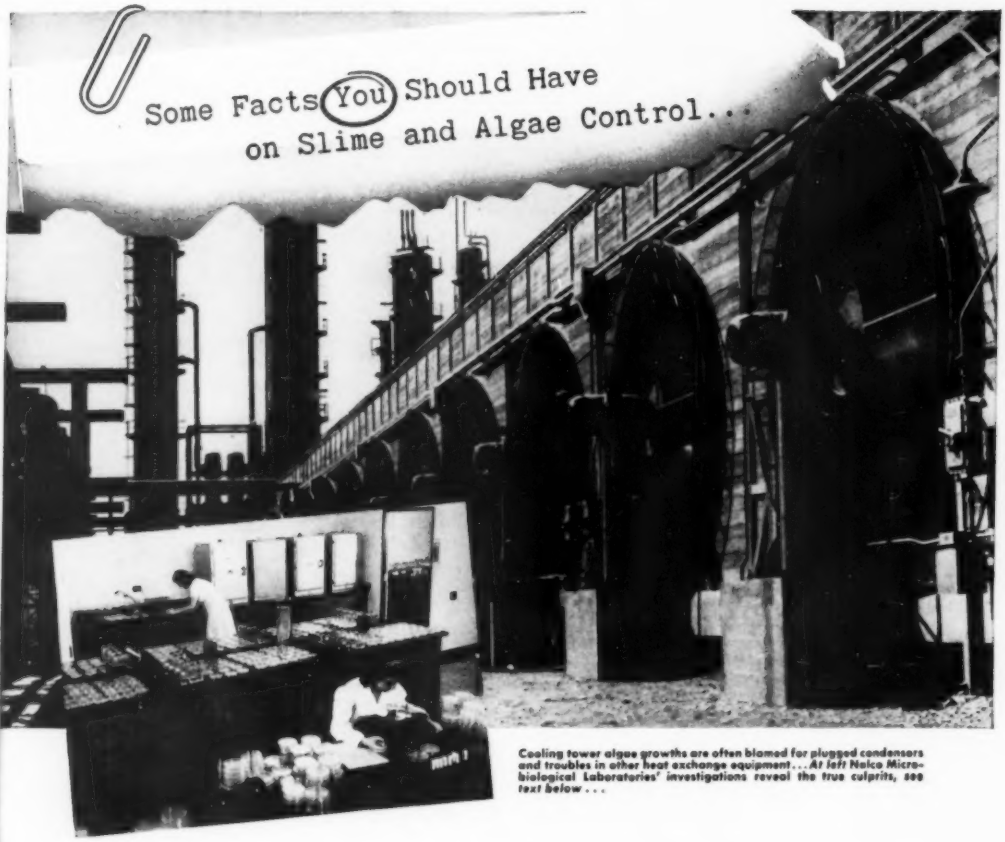
O. H. HUTCHINGS STATION
The Dayton Power and Light Company



SEWAREN GENERATING STATION
Public Service Electric and Gas Company

— SUPERHEATER, INC.
200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E



Cooling tower algae growths are often blamed for plugged condensers and troubles in other heat exchange equipment... *At left* Nalco Microbiological Laboratories' investigations reveal the true culprits, see *text below* . . .

ALGAE, the trouble-makers in cooling towers, seldom cause plugging, corrosion or iron oxide deposits in other parts of cooling systems . . . Nor can mold growths, slime-forming, sulfate-reducing and iron-depositing bacteria that do cause these internal difficulties be controlled with most algae-killing chemicals.

These established facts make it obvious that proper control of microbiological growths in any cooling system is first a job for experts. Proper identification, selection of treatment chemicals and dosages, and proper points of application will be handled efficiently and economically in your plant by Nalco Field Representatives, working closely with the Nalco Laboratories. Once proper microbiological control is established, consistent supervision to check effectiveness of treatment is all that is necessary to insure clean, slime- and algae-free equipment throughout your cooling system.

Your copy of Nalco Reprint No. 6, "A Practical Approach to the Problem of Cooling-Water Slime," will be sent promptly upon request . . . If your slime and algae control problem requires corrective action, now, write or call for a Nalco Field Representative.

FORMULA FOR SUCCESSFUL SLIME AND ALGAE CONTROL

- Identify slime-forming organisms to be controlled.

A NALCO SERVICE

- Determine the best types of treatment to be used.

A NALCO SERVICE

- Determine, by detailed survey, the proper method of application.

A NALCO SERVICE

- Provide consistent supervision to check application and effectiveness of treatment.

A NALCO SERVICE

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario, Canada

THE *Nalco* SYSTEM • Serving Industry through Practical Applied Science

Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. List the paragraph numbers of those you want on the card below, detach and mail

VALVES, PIPING AND ACCESSORIES

101 **Iron Body Gate Valves** — Bulletin 805, 8 pp, covers company's popular iron body, bronze trim gate valves in both outside screw and yoke and non-rising stem types, telling best applications for each. Design features are explained and illustrated. Gives dimensions, working pressures, and prices for company's standard line. Underwriter's standard valves for fire and sprinkler service, and gate valves with quick-opening, clean-out and other special features. The Ohio Injector Co.

102 **Bronze Valves** — Renewable composition disc bronze valves are featured in this bulletin. Shows different valves that comprise the group, assembled from the basic valve body and a few additional parts. Describes discs available provides disc guide for selection of proper type. Includes specifications, sizes. The Fairbanks Co.

103 **For Alloy Piping Systems** — Bulletin K-8 describes and pictures a new line of alloy welding fittings which incorporate a new design of greater wall thickness throughout for increased structural strength and extra thickness at critical areas for greater allowance against erosion and corrosion. Advantages of this principle for alloy piping systems are explained graphically and alloys which will be available are listed. Kay Co.

104 **Pipe Hanger Data** — Six-pp of engineering data on company's constant support pipe hangers is provided in Catalog 511. Explains design and advantages of the hanger, includes selection tables. Typical hanger arrangements are sketched. Bergen Pipesupport Corp.

105 **Line Type Purifier** — The uses, advantages and operation of company's line type Hi-eF purifier are discussed in Condensed Bulletin 200. Diagrams a vertical and horizontal installation, includes dimensions. The V. D. Anderson Co.

106 **Heat Insulation Data** — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Describes company's insulation products and provides data on thicknesses, sizes, physical characteristics of pipe coverings and blocks. Mundet Cork Corp.

INSTRUMENTS AND CONTROLS

107 **Electronic Recorders in Telemetering** — Instrumentation Data Sheet 9.1-9 describes Westinghouse Freq-O-Tron telemetering equipment as used with Brown ElectroniK recorders for long distance telemetering and high speed transmission of system variables to a central location. Discusses system requirements, general application, method of operation and design features. Includes photos of equipment, block diagrams of system components and line diagram for single station telemetering. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

108 **Resistance Thermometers** — Manufacturer's entire line of general and special purpose Thermohms to detect temperatures between — 325 to 1000 F are described and illustrated in 28-pp Catalog EN-84. To aid in selection, catalog provides a 5-pp tabular guide indicating proper instrument for each of numerous applications in a wide range of industries. This guide also tells how the Thermohm is used and where it is installed. Provides information about temperature conditions, corrosive agents, pressures, flows and other process conditions. Typical applications and installations are pictured. Specifications are given in tabular form. Leeds & Northrup Co.

109 **Cam Programmer Thermometers** — Illustrated Catalog 9020, 16 pp, describes a compact, efficient approach to the problem of time-temperature control. Describes the use, advantages, technicalities and versatility of this new instrument that combines as many as six functions from a standard sized instrument case. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

110 **Precision Instruments** — Designed to give quick information on all of company's precision instruments, 8-pp Bulletin 10A includes basic data on the Vibrotest for electrical insulation resistance testing, Vibroground for ground resistance testing, Hypot for hypotential dielectric strength testing, Donut instrument current transformers, precision ohmeters, volt-ammeters and other special purpose instruments. Associated Research, Inc.

111 **Combustion Control Case History** — Eight-pp Bulletin R-8 describes the operation of a large independent producer of electric power for manufacturing, Scovill Mfg. Co. The equipment and operating philosophy enabling this plant to achieve an evaporation rate of 12.8 and a cost per 1000 lb of steam of 70.6 cents is covered. Use of steam, fuel and ash handling, and plant steam demand are discussed and illustrated. A large schematic drawing shows operation of combustion control system, and a drawing of the instrument panel is tied into photos of functions performed by particular controllers. The Hays Corp.

112 **Magnetic Properties Meters** — Twelve-pp Bulletin GEC-777, describing application and operation of equipment used for measuring magnetic properties, covers company's gauss meter, indicating and recording fluxmeters, and fluxmeter calibrating unit. These instruments measure such magnetic properties as flux density, flux direction and total flux. Illustrated with photos, diagrams, includes prices. Meter and Instrument Dept., General Electric Co.

Use this CARD for information on ADS and NEW PRODUCTS also

FIRST CLASS
PERMIT No. 353
Sec. 34.9 P.L.&R.
CHICAGO, ILL.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING
110 South Dearborn
CHICAGO 3, ILLINOIS

PLEASE PRINT OR TYPEWRITE

April 1953
Card Valid to 7 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the following numbers.

.....
.....
.....
.....
.....

Your Name.....

Your Title.....

Your Company Name.....

Company Address.....

City.....State.....

(If you prefer delivery at your home also fill below)

Home Address.....

City.....State.....

Also, use this card for more information on advertised products

113 Continuous Sampling Monitor — Bulletin GEA-5735 presents a continuous sampling monitor, a new device to simplify quality control. Contains photos and diagrams of the equipment and explains monitor's operation, construction and range. General Electric Co.

114 Insulation Ohmmeter—Bulletin 1248 presents descriptive information on Megohmer insulation and resistance testers of both the d-c generator (hand-cranking) and non-cranking battery-vibratory types. Also describes an instrument for measuring resistance to 20,000,000 megohms and a Megohmmeter with Wheatstone bridge. Herman H. Sticht Co., Inc.

115 Precision Gages — Advanced type slack tube manometers, magnehelic gages, air filter gages, hook and smoke gages engineered for sensitivity and accuracy are highlighted in this new 12-p. catalog. These are new additions to company's line of portable and stationary gages. Illustrates instruments, gives sizes and other data and includes reference to specific literature covering each type of gage covered. F. W. Dwyer Mfg. Co.

116 Air Conditioning Smoke Detector — Bulletin AC-2, 2 pp describes and pictures company's smoke detector designed to automatically shut down the circulation in air conditioning ducts. Explains how this serves to prevent property damage and avert panic hazard caused by smoke coming from ducts. Ess Instrument Co.

WATER CONDITIONING

117 Scale and Corrosion Control — The 44-pp sixth edition of company's excellent text on organic methods of scale and corrosion control, this booklet provides a preliminary discussion of organic chemistry and its application to water treatment. Illustrated with photos, charts and graphs, many in color, explains organic water treatments and their use in the solution of problems encountered in boiler and cooling waters, steam and return condensate, brines and processing waters. Control methods are explained, sampling and proportioning. Properties of a number of gluconates are given, along with applications. Gluconate control test procedures are outlined. D. W. Haering & Co., Inc.

118 Water Conditioning Methods — Twenty-pp Bulletin 611 covers various methods of conditioning water and purposes served by each. Features an improved water softener designed to provide greater capacity and guard against loss of zeolite. Chemical feed, zeolite-post treatment, zeolite-alkalinity neutralization, and split-stream desilicization systems for boiler, process and general conditioning purposes are covered. Elgin Water Softener Corp.

PUMPS

119 For Higher Pressures — Bulletin L813B describes manufacturer's new cast IMO screw-type rotary pump available in capacities to 80 gpm for handling pressures to 275 psi continuous and 325 intermittent. It is described as a low cost, general service pump for petroleum products and other light viscous fluids as required for hydraulic systems, rotary and steam atomising oil burners, lubrication governing systems. Bulletin contains cutaway section of pump, descriptive matter, viscosity tables and dimensions for frame sizes. De Laval Steam Turbine Co.

120 Close-Coupled Pumps — Revised Bulletin 710-1, 12 pp, covers manufacturer's Close-Cupld centrifugal pumps of the single-stage enclosed impeller type. General construction details of these compact, easily installed pumps are described, illustrated by cutaway drawings. Specifications, performance data and dimensions given. Goulds Pumps, Inc.

121 Process Pump — Bulletin B-1605 describes a horizontal center-line mount for heavy duty process service, temperatures to 850 F, operating heads to 625 ft. Photos and cutaway illustrations show construction details of pump, text describes features. Includes specifications, engineering data. Pearless Pump Div., Food Machinery and Chemical Corp.

ELECTRICAL AND LIGHTING

122 Instrument Transformer Buyer's Guide — Fully illustrated Publication GEA-4626E is the 94-pp 1952 edition of company's catalog covering instrument transformers and it provides basic up-to-date information on the complete line. Gives ratings, ASA accuracy classifications and prices of indoor and outdoor potential and current transformers, metering outfits and potential and current portable transformers. Listings of ratio and phase-angle tests, together with tables on mechanical and thermal limits of current transformers are included. General Electric Co.

123 Variable Transformers — Complete engineering data on manufacturer's Powerstat variable transformers is provided in 16-pp Bulletin P650. Shows design features, availability of standard connection arrangements. Discusses motor drives (for all but smallest transformers). Gives detailed descriptive and dimensional information on seven basic types, also oil-cooled and explosion proof transformers, line correctors and 2-c power supplies. Ratings included. The Superior Electric Co.

124 Reduced Voltage Starters — Twelve-pp Bulletin 646 (second edition) covers manual transformer type reduced voltage starters for squirrel cage motors. Illustrates and discusses outstanding features, construction forms, operation, time delay and enclosures. Protective features are also detailed, and modifications, dimensions and price information given. Allen-Bradley Co.

125 Wire, Cable Calculator — This plastic calculator shows at a glance the approximate weight per 1000 ft of solid and stranded wire and cable with one, two or three conductors. On the reverse side is shown size of conduit or tubing needed for various numbers of conductors when using R, RH, RW, RF 32 and other cables, including lead-covered types. Also shown are allowable current carrying capacities of conductors in amperes, and there's a table giving ampere correction factor for room temperatures over 30 C. Triangle Conduit & Cable Co.

126 Factory Assembled Cubicles — A line of air blast breaker cubicle switchgear for both indoor and outdoor service is presented in this 16-pp bulletin. Following an illustrated general description of the factory assembled and wired units, booklet discusses in detail the control, interrupter and bus sections, disconnects, and safety features. Types of cubicles available are described. Also explains design and operation of the high speed air blast breaker; includes specifications. Brown Boveri Corp.

(*Continued on page 120*)

Use this CARD for information on ADS and NEW PRODUCTS also

PLEASE PRINT OR TYPEWRITE

April 1952
Card Void in 7 months

POWER ENGINEERING

Please have the manufacturer send me without obligation information or bulletins indicated by the following numbers.

1. .....
2. .....
3. .....
4. .....
5. .....

Your Name.....

Your Title.....

Your Company Name.....

Company Address.....

City.....State.....

(If you prefer delivery at your home also fill below)

Home Address.....

City.....State.....

Also, use this card for more information on advertised products

FIRST CLASS
PERMIT No. 353
Sec. 34.9 P.L.&R.
CHICAGO, ILL.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING

110 South Dearborn

CHICAGO 3, ILLINOIS

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

Dowell Service provided a fast, effective solution!

A midwestern power and light company, operating 350,000 lb. per hour steam generators, was having numerous unscheduled shutdowns because of tube failures. Although tubes were turbined periodically and inspections showed that deposits were small in amount, tubes continued to blister. A crisis was reached when 11 outages occurred in 18 days!

Dowell Service provided the answer with a *more effective, faster and more economical* method of maintenance cleaning. Tube failures at this power house have been practically eliminated. A regular cleaning schedule using Dowell Service has solved similar problems in many other plants.

What is Dowell Service? Experienced engineers fill the equipment to be cleaned with special liquid solvents designed to dissolve and disintegrate the profit-stealing deposits from all surfaces, even the most complex, *in a few hours.* The solvents are carried to the job in Dowell pump trucks and are pumped into the unit through regular connections. There is no dismantling.

Call Dowell for consultation on your cleaning problems. A Dowell engineer is as near as your telephone. No obligation, of course.

Other recent Dowell jobs:

Anthracite filters cleaned by Dowell Service in one working day. Backwash rate increased from 75 to 385 g.p.m.

★

Five air conditioning compressors cleaned for office building in 8 hours by Dowell Service. Result: $15.70 per day saved on power demand.

★

Two 40,000 lb./hr. boilers cleaned for paper company in 24 hours. Result: 37 tons of fuel per day saved under same load conditions.

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

CALL

New York 20	Pittsburgh 19	Ft. Worth 2	Mt. Pleasant, Mich.
Boston 16	Detroit 2	Shreveport 69	Hamilton, Ohio
Philadelphia 2	Chicago 4	Atlanta	Charleston, W. Va.
Baltimore	St. Louis 8	Indianapolis	Salem, Illinois
Wilmington 99	Kansas City 8	Louisville	Beaumont, Texas
Richmond 19	Wichita 2	Upper Montclair, N. J.	Borger, Texas
Jacksonville 2	Oklahoma City 2	Anniston, Alabama	Midland, Texas
Buffalo 2	Houston 2	Hattiesburg, Miss.	Wichita Falls, Texas
Cleveland 13	New Orleans 12	Lafayette, La.	Hobbs, N. Mex.

★ *Maintenance cleaning service for industrial heat exchange equipment.*

★ *Chemical services for oil, gas and water wells.*

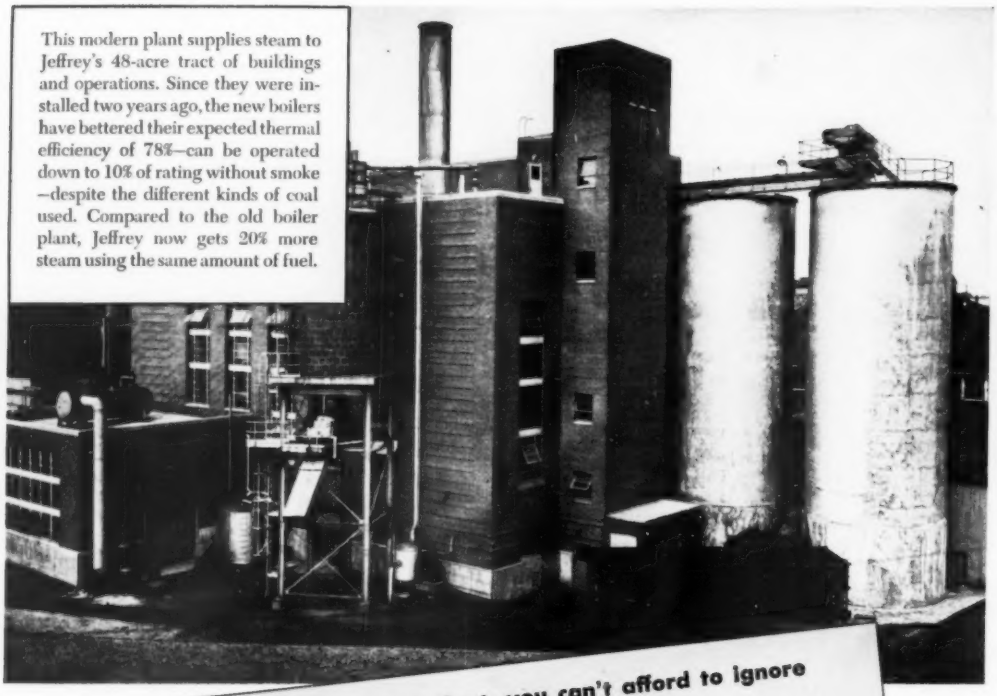
DOWELL

A Service Subsidiary of

THE DOW CHEMICAL COMPANY

"$52,000 A YEAR-

This modern plant supplies steam to Jeffrey's 48-acre tract of buildings and operations. Since they were installed two years ago, the new boilers have bettered their expected thermal efficiency of 78%—can be operated down to 10% of rating without smoke—despite the different kinds of coal used. Compared to the old boiler plant, Jeffrey now gets 20% more steam using the same amount of fuel.



If you operate a steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-priced fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

THAT'S WHAT JEFFREY SAVES BY BURNING COAL THE MODERN WAY!

AUTOMATIC, DUSTLESS COAL HANDLING SAVES US $9,980 IN LABOR ALONE,"

says H. W. deBruin, Vice President in Charge of Manufacture, The Jeffrey Manufacturing Company, Columbus, Ohio

This enclosed screw conveyor delivers coal to the main bunker over the firing aisle. *The entire coal handling system can now be controlled by one man.* Compared to the old method, Jeffrey saves $6,080 annually in car-unloading costs alone. And ash removal is completely automatic and dustless, too—saves an additional $3,900.

The plant's firing aisle—showing the two-ton traveling weigh larry that delivers coal to the boilers. Steam generating costs, not including depreciation, are—**old plant, $.598 per thousand pounds . . . new plant, $.455 per thousand pounds. Total savings, including savings in coal handling, amount to exactly $52,904 annually!**

Handle coal efficiently, fire it properly, and you can save *big* money! Today, modern combustion and coal-handling equipment add greatly to *bituminous* coal's inherent economy. You can now get anywhere from 10% to 40% more power from each ton of coal than was possible a few years ago.

If you are planning to modernize your present installation, or if you're building a new steam-generating plant, call in a competent consulting engineer. He'll give you the facts—show you how it will pay you and pay you well to burn coal in a modern installation designed to meet your specific needs.

And with coal you get the added advantage of a future dependability no other fuel can offer. Of all America's fuel reserves, 92% is coal. And to supply this coal, America has the world's most productive coal industry. For economy, for dependability, both now and for the future, you can count on coal!

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

Equipment News

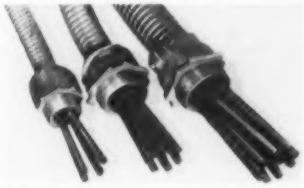
SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-paid card on pages 37 and 38 for your request. Just list the numbers of the items you'd like to know more about

1—ARMORED CABLE

For streamlining pneumatic and hydraulic control circuits

Armortube Cable is a flexible, protected multi-tube transmission line made up of ¼ in. OD aluminum or copper tubing gathered in a slow continuous spiral similar to the construction of rope. A tube bundle is first wrapped in water-repellent insulating tape, then encased in heavy rust-resistant, galvanized steel strip like that used for BX electrical cable.

Armortube has been designed to cut installation time and costs; save critical materials; protect instrument and control connecting lines, save space and improve plant appearance. Available in bundles of 4, 8 and 12 tubes, this cable is



declared capable of transmitting hydraulic control pressures as high as 3000 psig and all ranges of pneumatic control pressures. Connections and take-offs may be made in standard electrical junction boxes. Standard pipe or conduit clips may be used to fasten the cable to walls or ceilings. Company points out that a tracer tube easily identifies corresponding tube ends between cable connecting points, since all tubes in a bundle maintain same position relationships. Bailey Meter Co.

2—SAFETY CONTROL

For detecting and warning of oil leaks in heater tubes

The Paraprobe is an electrical device for continuously monitoring conductive liquids to detect undesirable contaminations and warn operating personnel. An exploratory electrode or probe is used to impose a fixed low voltage on the liquid stream under scrutiny. Contamination causes a change in electrical conductivity of the liquid, which soon causes the control relay to close the alarm circuit.

When used with oil preheaters, a second set of contacts in the snap-action switch controls the operation of the oil burner and oil pump. When used in a below-the-line heater installation, the probe is placed at the top of the horizontal heater shell, from which point it checks the condition of the boiler water as it passes through the heater. If an oil leak develops, company explains, the control relay opens the oil burner and oil pump circuits to stop the oil flow to the defective heater.

When used with steam oil heaters, the Paraprobe is placed in the condensate line from the heater and checks the quality of the condensate. By its reaction to the presence of oil in either the boiler water or steam condensate, the control acts to prevent the spread of oil contaminated circulation water or steam condensate to the boiler itself. Davis Engineering Corp.

3—PIPING HANGER

Constant support type, is light in weight and easily installed

Several new design features have been incorporated in this hanger to alleviate installation and operating problems, manufacturer states, and it achieves constant support for piping under all load and travel conditions. It is designed to permit normal longitudinal as well as transverse movement without impairing its efficiency. It has few moving parts, uses only one compression spring and requires no compensating device. It has permanently lubricated needle bearings and self-oiling bushings.

Company says this new hanger is lightweight, compact, easy to install and requires no maintenance. Travel is indicated by a large pointer with a full swing of approximately 7 in., and this pointer serves a magnified direct reading indicator. Positions are marked by large bars or brass buttons. The hanger is available in 25 graduated sizes ranging in travel from 2 to 12 in. and in load capacities from 50 to 8380 lb. Units can be coupled or used in multiples for increased capacity. Bergen Pipesupport Corp.

4—80-W P-A AMPLIFIER

For covering large areas, overcoming high noise levels

This 80-w amplifier is the "super power" unit of the Knight series of public-address amplifiers. It was especially designed for high-power paging, and actual coverage of the unit is given as 260,000 sq ft when used with such accessories as trumpet-type speakers. Operation is from 110–130 v, 50–60 cycle a-c, with transformer taps at 117 and 130 v. Allied Radio Corp.

6—VARIABLE SPEED DRIVE

With explosion-proof motor, for use in hazardous locations

In contrast to the more conventional method of connecting an explosion-proof motor with a separate speed changer, this new design is self-contained, all mounted in one frame, occupying a single base. The motor element is totally-enclosed and air movement is blasted over the enclosed units from the exterior by a spark-proof fan housed within the end sector. The motor unit is mounted on company's Varidrive assembly.

By turning a control dial, change in speed is provided instantly. The motor is available in output speeds from 2 to 10,000 rpm in ratings from 1 to 20 hp. When gear reductions are necessary they are incorporated as an integral unit of the drive. U. S. Electrical Motors Inc.

7—POLYESTER FILM

Now in experimental stage, shows promise as electrical insulation

Mylar is a polyester film, similar in appearance to cellophane, but with distinct properties. A sparkling, transparent, colorless film, it is described as tough and durable and retaining flexibility at very low temperatures. Its high strength is expected to permit thinner gages.

Other advantages announced for Mylar are ability to retain dimensions and properties through a wide temperature range, and intermediate electrical polarity. This latter property permits Mylar to store electrical energy, a requirement for use in condensers. Also, it is said to have high dielectric strength, or insulating power, without excessive power loss, a requirement for conductor insulation. And tests are reported to show that Mylar excels all existing materials for electric motor insulation except mica, which is fragile, expensive and in short supply.

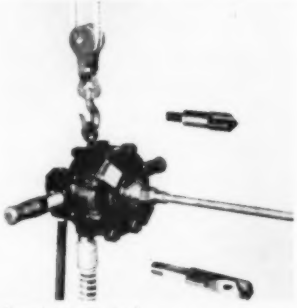
Mylar is a condensation polymer obtained from ethylene glycol and tereph-

5—VERSATILE CONDENSER CLEANERS

Overhead suspension type, are designed for cleaning small, straight tubes

With the proper selection of cleaning tools, these new cleaners are declared equally efficient in removing either hard or soft deposits. In operation, they are supported from overhead by means of a trolley, rope-block or hanger. Two ball type thrust bearings, as used for years in company's heavy-duty refinery tube cleaners, absorb the push and pull forces imposed during operation.

A notable improvement in the control system is a control valve actuated by a "squeeze" trigger at the base of one of the operating handles. This trigger is convenient to operator's right hand, company says, but not in a position to be opened accidentally. It actuates a throttle valve which can be regulated continuously from wide open to shut-off. When the operator releases the trigger, the valve opens and the motor stops. The same trigger controls the flow of water for cooling the drills and flushing out scale, and the water-feeding mechanism has a new self-adjusting packing which can be changed to handle water or

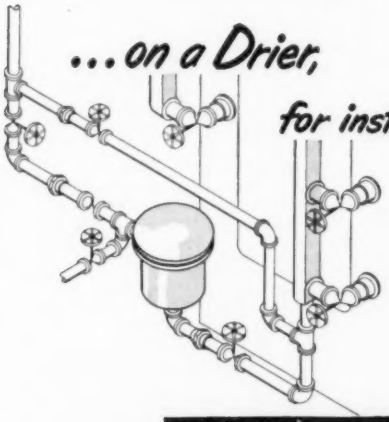


solvent, as required.

Two new drill heads (shown) are available for the cleaners — a drill tip and adapter for soft, gummy deposits, and a carbide-tipped drill for hard deposits. Lagonda Div. Elliott Co.

Example of Steam Trap Durability

...on a Drier, for instance



THE INSTALLATION

On heavy-duty, steam-heated tumbler-type drier at American Linen Supply Company, Cincinnati.

THE HISTORY

A high discharge capacity trap was needed to operate this drier 16 hours daily under heavy loads, with 125 psi. steam. Specifications called for rapid, fully automatic condensate removal to insure fast warm-ups and a steady flow of hot, dry steam to the drier. Naturally, the lowest possible trap maintenance cost was also wanted.

The choice was a Crane 150-Pound Inverted Open Float Steam Trap, carefully selected for adequate drainage capacity, and above all, properly installed.

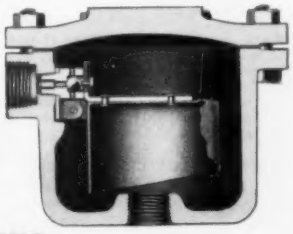
In service more than 8 years and never needing any repairs or new parts, the Crane trap has given complete satisfaction. Total maintenance expense: periodic routine inspection only.

TRAP SERVICE RATINGS

SERVICE LIFE:	More than 8 years - Heavy duty
SUITABILITY:	High discharge capacity
MAINTENANCE COST:	None - Routine inspection only
SPECIAL FEATURES:	Simple, dependable mechanism
OPERATING RESULTS:	Fast warm-ups - Steady even heat
PRICE:	Good Buy
AVAILABILITY:	Stock item in Crane line

THE TRAP

Crane Iron Body Inverted Open Float Steam Trap, for 1 to 300 pounds saturated steam working pressures. Small and compact in all sizes, yet has high discharge capacity. Patented ball-type seating gives positive pressure seal. Simple operating mechanism with only one moving unit assures durable, trouble-free performance. See your Crane Catalog or your Crane Representative for complete data on these highly efficient traps.



The Complete Crane Line Meets All Valve Needs. That's Why

More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

thalic acid, chemically similar to Dacron fiber, but cast in sheets instead of spun. E. I. du Pont de Nemours and Co., Inc.

8—FLOW LINE INDICATOR

Is incorporated into line to permit visual inspection

The Liquid Eye Line Indicator consists of a brass housing in which is inserted a transparent high pressure Pyrex tube with a ceramic eye which visually magnifies when liquid line is full. The "straight-through" design eliminates pressure drop, company points out, and construction is not affected by most commonly used chemicals, solutions and oils.

Liquid Eye Line Indicators are suggested for use in boiler feedwater conditioner lines, in oil pressure lines, diesel fuel oil lines, refrigerant and other chemical lines and similar installations where a quick check of flow is required. Three styles are available in copper tube sizes of ¼, ⅜, ½ and ⅝ in. with male flare ends, female to male flare ends with copper flare insert in female end, or with solder connections. Allin Mfg. Co.

9—TEST-STAND

With dual head to permit wider variation in take-off speeds

To determine operating characteristics of such component parts as vacuum pumps, alternators, hydraulic pumps and compressors, this new Aero Test-Stand with a dual head permits two component parts to be tested at one time. The test-stand consists of a variable speed motor which can be changed from one speed to another by turning a control dial. Brackets are mounted on the motor to accommodate various components to be tested.

The horsepower for continuous duty is from 7½ to 50, and for intermittent duty from 10 to 75. The ratio between the two shafts is usually 2:1. Speeds and ratios may be changed to meet user's requirements, and the test-stand can be supplied with a tachometer which will give direct readings for both shafts. U. S. Electrical Motors Inc.

10—BELT DRIVEN FAN

Heavy-duty, for use against moderate static pressure

This power line duct booster fan, the Type PLDX, is intended for use in large range hood exhausters or in ventilating or heating systems, and is recommended for air movement up to 350 F. It is described as relatively quiet, and will operate against static pressure up to 2 in.

The fan is equipped with non-overloading cast aluminum airfoil type propellers. These units are ball bearing and the motors are semi-enclosed or explosion-proof as required. Hoods can be supplied for outside mounting. The units are available in 16- to 36-in. sizes, air deliveries from 2700 to 23,000 cfm. Chelsea Fan & Blower Co., Inc.

11—COMPACT CONTROLLER

For electric circuits, features large power handling capacity

Newest of company's Regohm devices for converting low-power-level signals into control signals of a much higher power level is the Regohm Size 3. A plug-in unit, it is described as a highly adaptable control for voltage, current or speed regulation and adaptable to functions in servo systems. Its design is said to make it adaptable to rotating machinery, line and load regulation, rectification, battery charging, saturable reactors and close differential relays.

The unit is available in a variety of forms; it can be built with 20 standard fingers of 1 amp, 12 w capacity, or 10 extra heavy fingers of 3 amp capacity. Fingers may be connected in parallel when control circuit currents are greater than these values. The coil circuit can be operated from signal sources of widely varied voltages and frequencies. The unit operates directly on d-c or 50 to 60 cycle a-c. It is 2 by 2 by 2 in. in size and can be hermetically sealed. Electric Regulator Corp.

12—COLD-SETTING CEMENT

To protect outdoor heat-insulated pipe lines and equipment

Neither winter cold nor summer heat and rainstorms can materially damage outdoor heat-insulated pipe lines protected with Nerva-Plast, says manufacturer. The product is described as a compound of rubber and asphaltic hydrocarbons which, on drying, forms a tough, resilient film. This is said to remain contiguous and be impervious to water and moisture vapor penetration.

Nerva-Plast may be applied directly to the pipe or used as an adhesive coating for heat insulation materials — aluminum foil, Fiberglas fabric, Foamglas and 85% Magnesia. Nerva-Plast also acts as a waterproof adhesive when applied to insulating material on housings, condensers, pumps and valves. In some cases a coating of Nerva-Plast applied to outdoor piping is all the waterproofing and weatherproofing required. Rubber & Plastics Compound Co., Inc.

13—WINDING HEAD

Three-phase type, features an automatic tension device

This new head winds mush type coils for motors from ¼ to 75 hp and is capable of winding coils from 2¼ by 5 in. to 11½ by 19½ in. When in operation arms are held rigid, but when the coil is finished, tension is released by simply pulling the arms out and turning inward in one easy motion. The coils then slip off.

A new wire guide is provided to enable operator to guide the wire into place and insure uniformity of coils as well as utilize operator's maximum winding space. The head is adjusted by four permanently adjusted cranks; it is not necessary to remove head to make adjustments. Crown Industrial Products Co.

14—INSULATION TESTER

Is compact, portable instrument, for direct reading

A special safety advantage is stressed for this instrument: In case the operator should get across the test leads, the dead short circuit is limited to a maximum of 100 mu-a, or 1/10 of a milliampere. The indicator is a direct reading d-c microammeter, is calibrated directly in megohms and measures insulation resistance to 1000 megohms.

On dead short, the meter deflects full scale, the internal resistors limiting the current to 100 mu-a. Company points out that this meter has the ability to discriminate between a complete insulation breakdown and leakage through insulation. It will pick out a device in which insulation resistance is substandard and could be expected to fail in service.

The complete tester, including leads, weighs 14 lb, and requires only plugging into a 115 a-c outlet for use. Eastern Specialty Co.

15—CONCRETE PAINT

For interior or exterior concrete, cement block, brick and stone

The new Smooth-On No. 15 doesn't require primers or sealers and can be applied to painted or unpainted dry or damp surfaces, company says. A gallon covers approximately 400 sq ft and one coat is usually all that is required. An important feature announced for the new paint is its high resistance to water, acid or alkaline attack. It is also pointed out that surfaces coated with No. 15 can be washed without damaging the finish. It is medium gray in color, costs $5.00 per gal. Smooth-On Mfg. Co.

16—INSULATING FILM

For high temperature, high voltage, high frequency applications

"Scotch" brand PTF film (made from Teflon) is made by a process that produces fewer air entrapments in the film than previous insulation materials of its type, company explains — two layers of 3-mil film, for example, form a continuous surface giving positive dielectric protection at a 5000 v level.

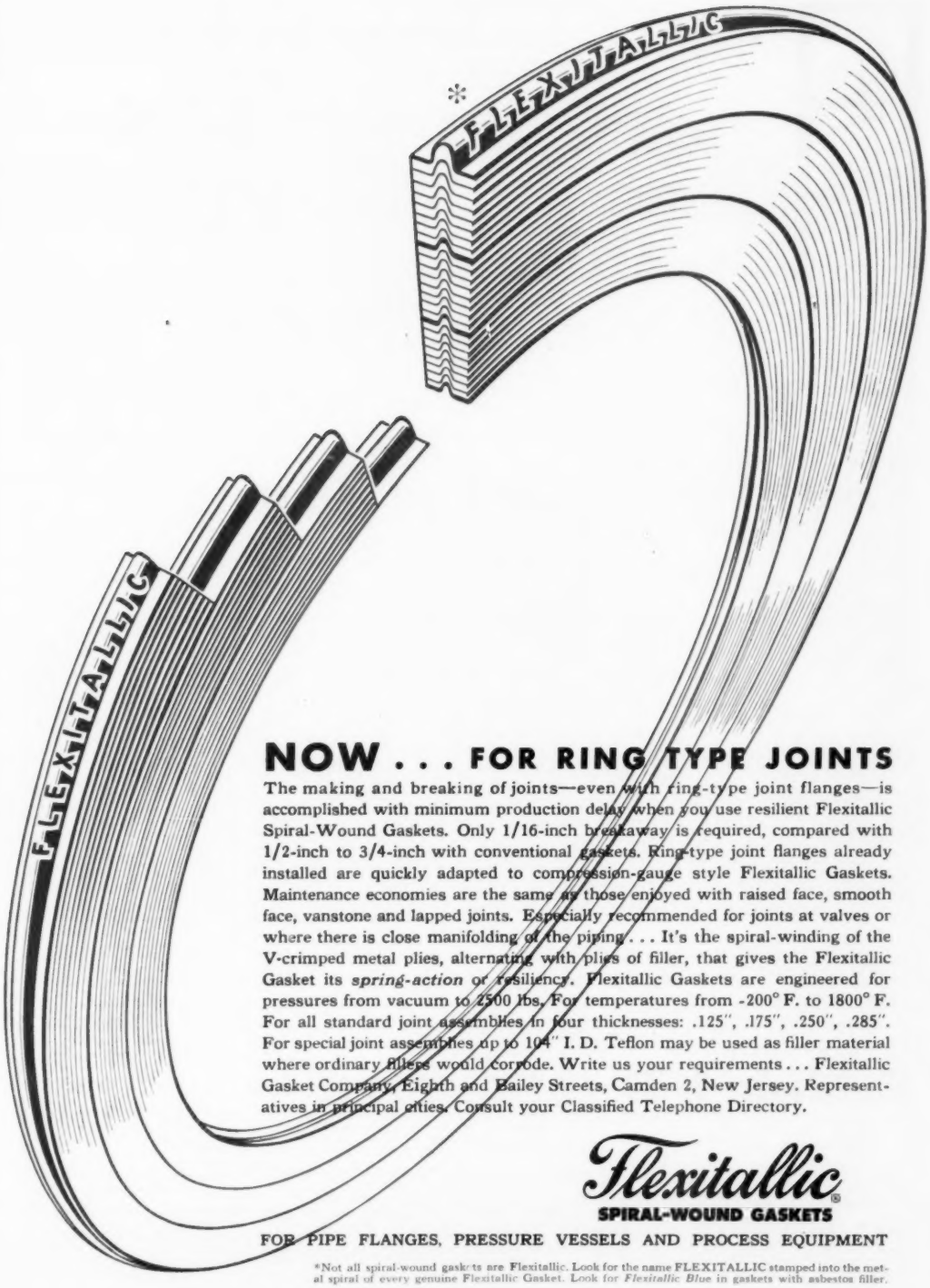
Several advantages are announced for this translucent film: It withstands temperatures from −100 to 500 F and meets Class B and Class H requirements, permitting use in construction of Class H capacitors. It is non-flammable, will not track, resists most solvents, is unaffected by impregnating varnishes and won't absorb moisture. It is also said to resist cold flow under pressure, and to have a tensile strength of 7800 psi. The film comes in 36-yd rolls in widths from ¼ to 6 in.; in thicknesses of 3, 5, 10 and 15 mil. Minnesota Mining and Mfg. Co.

17—"HAND" CALCULATOR

Is easily operated, versatile device that weighs only 8 oz

This little portable calculator is designed to add, subtract, multiply, divide, figure

square roots, factors, cubes and percentages. It's precision made by Swiss watchmakers, manufacturer says, and is amazingly accurate. It carries to five decimal places and totals to 99 billion; figures can be checked on three sets of dials. According to company, it's as easy to use as a slide rule and does as much as many desk calculators costing several times its price — $129.00 including rubber-lined metal case. Curta Calculator Co.



NOW . . . FOR RING TYPE JOINTS

The making and breaking of joints—even with ring-type joint flanges—is accomplished with minimum production delay when you use resilient Flexitallic Spiral-Wound Gaskets. Only 1/16-inch breakaway is required, compared with 1/2-inch to 3/4-inch with conventional gaskets. Ring-type joint flanges already installed are quickly adapted to compression-gauge style Flexitallic Gaskets. Maintenance economies are the same as those enjoyed with raised face, smooth face, vanstone and lapped joints. Especially recommended for joints at valves or where there is close manifolding of the piping . . . It's the spiral-winding of the V-crimped metal plies, alternating with plies of filler, that gives the Flexitallic Gasket its *spring-action* or resiliency. Flexitallic Gaskets are engineered for pressures from vacuum to 2500 lbs. For temperatures from -200° F. to 1800° F. For all standard joint assemblies in four thicknesses: .125", .175", .250", .285". For special joint assemblies up to 104" I. D. Teflon may be used as filler material where ordinary fillers would corrode. Write us your requirements . . . Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult your Classified Telephone Directory.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* in gaskets with asbestos filler.

Powerhouse Cement is a star performer in the Baldwin-Hill line of insulating materials. Consider these advantages:

- **Effective to 1700° F.**
- **One coat—points, seals, insulates**
- **No wire mesh . . . high adhesion to blocks, blankets, or plastic cement**
- **Finishes and insulates . . . figure its thickness as part of insulation**
- **Withstands drenching rain two hours after application**
- **Takes oil or water base paint direct**

Powerhouse Cement is one of a complete line of B-H *Black* Rockwool insulating materials — block, blanket, cements, etc. A B-H representative will gladly show you how to reduce heat loss on the job — THERM-ENOMICALLY.

"Economics of Engineered Heat Control

Baldwin-Hill

Clip this coupon and attach to your signed letterhead

SEND ME COMPLETE INFORMATION ON:

- ☐ Powerhouse Cement—High adhesion finishing to 1700° F.
- ☐ Blankets—metal reinforced, large-area coverage to 1200° F.
- ☐ No. 1 Cement—plastic insulation, to 1000° F.
- ☐ Mono-Block—for temperatures to 1700° F.

BALDWIN-HILL CO., 907 BREUNIG AVE., TRENTON, N. J.

18—BURETTE UNIT

Has plastic reservoir, automatic self-leveling burette

The Squeeze-O-Matic is designed for easy, quick use and requires only one hand for operation. A squeeze of the polyethylene reservoir is all that's needed to fill the burette, company says, and this plastic bottle provides a container that is highly resistant to chemical attack and won't contaminate standard titrating solutions.

The new unit also has a plastic base which holds the reservoir and provides a stable platform for beaker, flask or dish. A molded stopper arrangement for the bottle holds the burette in position and provides a seal between bottle top and burette. The units come in 25 ml and 10 ml sizes graduated in tenths of a milliliter. A development of Hall Laboratories, Inc., the Squeeze-O-Matic is distributed through associated companies. Hagan Corp.

19—NULL INDICATOR

Is hermetically sealed, for use under severe conditions

The hermetically sealed Ruggedized Null Indicator is designed to permit use of the null system for precise measurement under conditions formerly considered prohibitively severe. Although its center-point sensitivity is high (1 microampere per mm or higher), the meter's shaded pole face and shielded core construction is said to give sharply logarithmic attenuation as it departs from null point, and to provide ample overload protection. Stated maximum current is ten times rated full scale value. Two models are offered, the HS2 ($2\frac{1}{2}$ in. size) and the HS3 ($3\frac{1}{2}$ in. size) both available with numerous current sensitivity and internal resistance characteristics. Marion Electrical Instrument Co.

Catalog Library

THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the postage-paid card on pages 37 and 38 for your request

WATER CONDITIONING

201 Water Conditioning Information — Here are three informational bulletins. No. 28X7446 describes a simple way to determine total hardness in water, illustrating procedure. No. 28X7559 gives an analysis of the hot process-hot zeolite system telling results to be expected. No. 28X7466 discusses current status of embrittlement in boilers, explaining causes and telling recent developments in control methods. List bulletins wanted. Allis-Chalmers Mfg. Co.

202 Modern pH and Chlorine Control — This 100-pp booklet gives details of company's color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

203 Water Softening Equipment — How problems caused by hard water can be offset by water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. The Permutit Co.

204 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

205 Chemical Treatment of Water — Bulletins describing various methods of chemical water treatment, including company's Coravol process, are available. Coravol is part of a complete technical service which provides special chemical formulas for boiler feed water, foam prevention, hot water supply, refrigerating brine, cooling and condenser water. Western Chemical Co.

206 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes available equipment and includes reference bibliography of literature on specific formulations. Dearborn Chemical Co.

207 Boiler Corrosion — A 12-pp article discussing cause and prevention of corrosion in boiler systems is presented in Betz Technical Paper No. 111. The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity, physical factors are evaluated. W. H. & L. D. Betz.

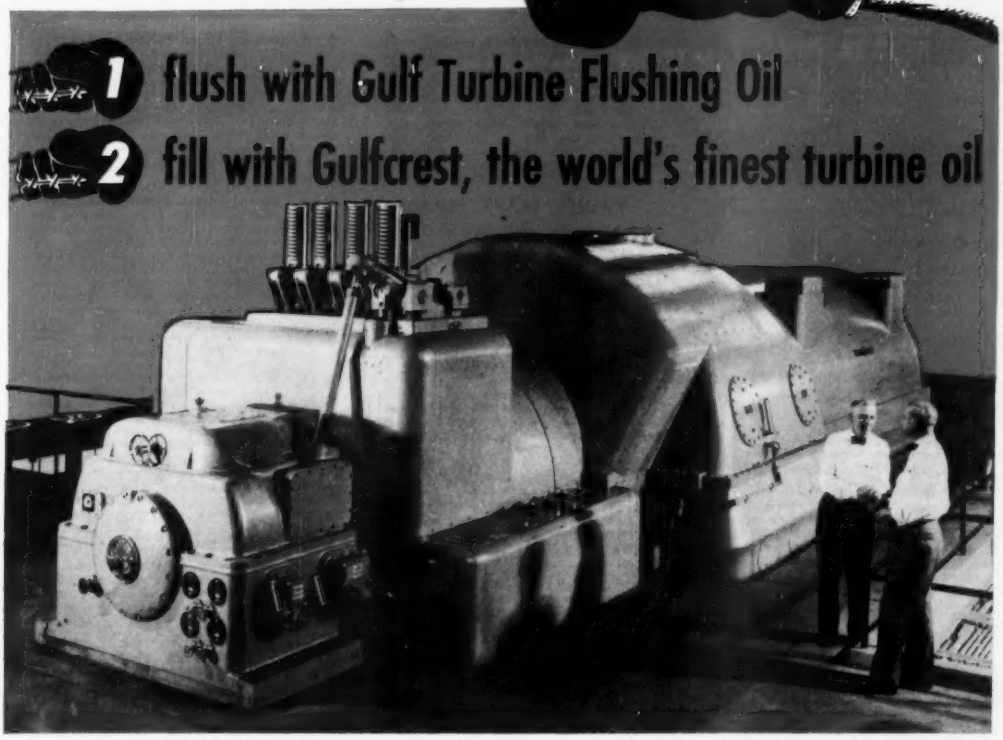
208 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition and application. Wright Chemical Corp.

209 Zeolite Water Softeners — Publication 4530, 16 pp, presents hydrogen zeolite (cation exchange) water softening equipment. Gives complete description of the process and the field of application, showing advantage of hydrogen zeolite softening and its relation to sodium zeolite softening process. Cochrane Corp.

210 Slurry Type Softener — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. Question-and-answer appraisal of system. Worthington Pump and Machinery Corp.

211 What's New on Ion Exchangers — Here are three booklets covering company's ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic

Fight deposits and oxidation in turbine lubricating systems with GULF'S famous 1-2 PUNCH



By taking these two steps, you can insure top lubricating efficiency down through the years for your new steam turbine.

The use of Gulf Turbine Flushing Oil—before the initial fill of lubricating oil—will remove grease-type slushing compounds and carry away harmful abrasives which might be in the circulating system. And, it protects all oil-bathed surfaces against rust. Because Gulf Turbine Flushing Oil is itself a satisfactory lubricant, the undrained portion does not impair the lubricating value of the turbine oil.

Then, to keep the new system clean, fill with Gulfcrest Oil. Because of its outstanding resistance to oxidation, Gulfcrest maintains an exceptionally low neutralization number, and lasts indefinitely. With this high quality oil and good operating practice, you can be sure there will be no sludge deposits in cooler tubes, bearing pedestals or oil lines to worry about.

To get these benefits for your new turbines, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office.

Gulf Oil Corporation · Gulf Refining Company
Pittsburgh 30, Pennsylvania

GULF SERVES INDUSTRY

gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

212 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and to feed-water system, condensate returns, flushing. % Proportioneers, Inc. %

213 Feedwater Treatment — Here is a 10-pp illustrated report on boiler feedwater treatment for a high-pressure, high-makeup power and steam producing plant. It is based on studies to determine best method of meeting requirements for both the high-pressure steam used in power generating turbines and the district heating steam for downtown Philadelphia. Reasons for deciding on a demineralising plant are explained, together with studies of demineralizing systems and cation and anion exchangers from which selection was made. Equipment installed and operating results are explained. Graver Water Conditioning Co.

214 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment are described. Tells how tests determine water hardness, hardness due to calcium alone and hardness due to magnesium alone. Hall Laboratories, Inc.

FUEL OILS, LUBRICANTS

215 Fuel Oil Treatment — By text and sketches, this folder points out undesirable conditions in the storing, pumping, heating and burning of industrial fuel oil and correction of these conditions by company's treatment. E. F. Drew & Co., Inc.

216 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is explained. Other chapters cover injection systems, combustion chambers, also lubricating systems, and diesel oil purification and filtration. Includes discussion of fuel and lubricating. Sinclair Refining Co.

217 Viscosity of Fluids — The larger significance of viscosity is discussed in Nos. 5 and 6, Vol. 36 of Lubrication, a technical publication. In six parts, the first illustrates simplest conception of streamline flow between two surfaces having relative motion. A series of torsion viscometers shows how viscosity acts and may be measured. Part II covers streamline flow in capillary and other small tubes. Part III covers turbulent flow in pipes. Part IV discusses effects of temperature and pressure on viscosity, and Part V includes viscosity index. Part VI gives brief reference to nature of plastic flow. The Texas Co.

218 Clean Oil for Diesels — A combination purifying and filtering unit utilizing centrifugal force and controlled filtration is the subject of illustrated Bulletin DL-1. Explains operation of the unit, tells advantages. Discusses importance of clean, dry lubricants. Also discusses purification of fuel oil for diesel engines. The DeLaval Separator Co.

219 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil, and the question of system efficiency, as affected by circulation rate and system. Bowser, Inc.

220 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co.

221 Lithium Soap Greases — Twelve-pp. Booklet AD3084, on manufacturer's Stanolith greases, explains how they withstand both high temperatures and wet operating conditions. Discusses two grades — one recommended for central dispensing systems, and a heavier grade for compression cups or pressure gun applications. Difficult lubrication jobs successfully handled by Stanolith greases are described and pictured. Standard Oil Co. (Ind.)

222 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel and heating oils, dust control. Examples of increased production and lowered costs resulting from use of this service are cited. Gulf Oil Corp., Gulf Refining Co.

VALVES, TRAPS, PIPING

223 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes — 150 to 2500 lb — and include globe and angle, gage, instrument, hydraulic and relief types, also strainers, and check, gate, non-return and blow-off valves. Explains design features. Edward Valves, Inc.

224 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering and application data; includes a section on products for refrigeration service. Fully illustrated, indexed. Available to qualified power engineers, please give your title. Henry Vogt Machine Co.

225 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, dimensions; pictures typical installations. Also discusses variations. The Chapman Valve Mfg. Co.

226 Valve Specialties — Included in 90-pp Catalog A-50 is complete ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves, pilot valves; back pressure, relief and non-return valves, stream trap and air vent; liquid level controllers; solenoid valves. Includes capacity charts. Davis Regulator Co.

227 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-downs, and other types of pipe line. Includes dimensions, weights; prices. Everlasting Valve Co.

228 Forged Steel Valves — Form 800-A describes 600-lb forged steel valves for high line pressure and temperature applications. Covers both inside screw and OS&Y union bonnet gate types, giving sizes, prices. The Ohio Injector Co.

229 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

230 High Pressure Gate Valve — Described in 4-pp Form DH-273 is a forged steel gate valve designed for long service and low cost maintenance. Working pressures, sizes and prices listed. R-P & C Valve Div., American Chain & Cable Co., Inc.

231 Pressure Reducing Valves — Selection and engineering data on pressure reducing valves, including those for remote control of reduced steam or water pressures, are presented in 12-pp Bulletin 477-A. Northern Equipment Co.

232 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

233 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air, gasoline, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb. W. H. Nicholson & Co.

234 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure traps sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, prices. Yarnall-Waring Co.

235 Solving Steam Trap Problems — This popular 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install traps and service them. The V. D. Anderson Co.

236 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

237 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co.

238 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. E. M. Dart Mfg. Co.

ELECTRICAL

239 Power Factor Correction — Examples showing basic considerations in the improvement of system power factor are contained in Bulletin O5B7465. Points out advantages of improving plant power factor and advisability of keeping load power factor up to 0.8 lagging or higher; tells how the effects of low power factor can be corrected. Allis-Chalmers Mfg. Co.

240 Co-ordinated Protection of Motors — The interlinked protection of circuits, motors and personnel is explained in 12-pp Bulletin DB-4673 on high-voltage combination starters. Because almost every 2300/4800 v power system can produce high

(*Continued on page 156*)

Nipple that failed after one year in main condensate line.
Corrosion of threaded area caused leakage in return line.
these parts were destroyed by RLC
Carbonic acid corrosion eats right through cast iron elbow.
Nipple shows characteristic pitting due to dissolved oxygen.

prevent Return Line Corrosion with Dearborn Formula 700 or 702

These destroyed parts were the victims of *return line corrosion.* If your maintenance costs are high because leaking or clogged return lines require replacement—if rusty condensate is coming back to your boilers—then it will pay you to use Dearborn Formula 700 or 702.

Return line corrosion is caused by oxygen and carbon dioxide. It can be effectively controlled thru the easy, inexpensive application of either the neutralizing amine-type treatment (Formula 700) or Dearborn's new filming-type amine treatment (Formula 702).

Your Dearborn Engineer is prepared to make specific recommendations on the use of Dearborn Formula 700 or 702 in your plant.

DEARBORN CHEMICAL COMPANY
Merchandise Mart Plaza • Chicago 54, Illinois

NOTE: Dearborn holds the basic patent (U.S. Pat. 2400543) for the use of *filming amines* for treating water.

WRITE FOR THIS BULLETIN

Write for Bulletin 5013 which outlines causes of return line corrosion and describes how it can be controlled by Dearborn Formula 700 or 702.

Dearborn Chemical Company, Dept. PG
Merchandise Mart Plaza, Chicago 54, Ill.

( ) Send a copy of Bulletin 5013
( ) Have a Dearborn Engineer call

Name.....

Position.....

Company.....

Address.....

City.....Zone....State.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

POWER PLANT *Construction News*

McIntosh, Ala. — Calabama Chemical Co., Inc., Huntsville, Ala., agricultural chemicals, plans boiler house at proposed new plant at McIntosh, where tract of about 30 acres of land has been selected. It will comprise several factory units and is reported to cost approximately $500,000, with equipment. Proposed to begin work soon.

Trussville, Ala. — Appleton Electric Co., 1713 West Wellington Ave., Chicago, Ill., conduit fittings, lighting apparatus, etc., plans boiler house at proposed new plant at Trussville, where site has been acquired. It will comprise a main one-story building and several auxiliary structures. Cost reported close to $1,000,000. Work is expected to begin this spring. J. E. Sirrine Co., 215 Main St., Greenville, S. C., is architect and engineer.

Tucson, Ariz. — Central Arizona Light & Power Co., 501 South Third Ave., Phoenix, Ariz., plans new steam-electric generating plant in vicinity of Red Rock (Pinal County), about 35 miles from Tucson. Installation will include a 100,000-kw turbine-generator unit, high-pressure boilers, and auxiliary equipment. Cost reported about $12,000,000, including power substations, transmission lines, etc. Another generating unit of like capacity is planned at later date.

Avon, Calif. — Monsanto Chemical Co., Western Division, 911 Western Ave., Seattle, Wash., plastic paints, resins, adhesives, etc., plans boiler house at proposed new plant near Avon, where tract of about 80 acres of land has been acquired. It will consist of several processing and production units for manufacture of phenol. Entire project reported to cost about $3,500,000. Work is scheduled to begin early next summer.

Tampa, Fla. — Tampa Electric Co., Tampa, is arranging fund of $7,000,000, for expansion in power plants and system during present year, including extensions in generating capacity, power substations, transmission lines, and other operating facilities. During next 60 months (1952–56), company plans gross expenditure of $52,000,000 for similar work.

Albany, Ga. — Merck & Co., 126 East Lincoln Ave., Rahway, N. J., drugs and medicinal chemicals, plans boiler house at proposed new plant near Albany, where tract of about 640 acres of land has been secured, fronting on Flint River. It will comprise several one-story buildings for processing and production. No official estimate of cost announced — will represent sizable investment. Work is expected to begin at early date.

Doctortown, Ga. — Rayonier, Inc., 122 East 42nd St., New York, N. Y., wood cellulose, paper pulp, etc., plans power house at proposed new mill, for production of purified wood cellulose, at Doctortown, near Jessup, where tract of over 500 acres of land has been secured, fronting on Altamaha River. It will comprise a number of production units, with rated output of 250 tons per day. A pumping station will be built. Entire project reported to cost about $25,000,000.

Decatur, Ill. — Illinois Power Co., 134 East Main St., has arranged a construction budget of about $56,000,000 for expansion and improvements in plants and system during next 24 months (1952 and 1953). Work will include extensions in generating capacity, power substations, transmission lines, and other operating facilities.

Lemont, Ill. — Brad-Foote Gear Works, 1309 Cicero St., Cicero, Ill., gears and transmission systems, plans boiler plant at proposed new one-story factory, about 45,000 sq ft floor space, at Lemont, near Cicero. Entire project reported to cost about $500,000.

Marion, Ind. — Midwest Paper & Envelope Co., 11th and Adams Sts., Marion, envelopes and other commercial paper products, plans boiler house at proposed new plant on local site of about 10 acres of land. A main one-story structure, 240 x 525 ft, will be erected for converting service. Entire project is reported to cost about $750,000. Work is expected to begin at early date.

Mason City, Iowa — North Iowa Cooperative Processing Association, Manly, Iowa, soybean products, plans boiler plant at new soybean oil mill at Mason City, comprising a main and multi-story building for processing and general production, and several auxiliary structures. Proposed to begin work in spring. Entire project reported to cost $1,500,000. R. W. Booker & Associates, 1722 Olive St., St. Louis, Mo., is engineer.

Hagerstown, Md. — Municipal Electric Light Dept., City Hall, has plans under way for new addition to municipal electric light and power plant, with installation of equipment for increased capacity. No estimate of cost announced. Albert C. Wood Associates, 1411 Walnut St., Philadelphia, is Pa., consulting engineer.

Chelsea, Mass. — Dept. of Welfare, Commonwealth of Massachusetts, 15 Ashburton Pl., Boston, Mass., has approved plans for addition to power house, at Soldier's Home, Crest Ave., Chelsea, to cost approximately $150,000, exclusive of equipment. Work scheduled to begin at once. Office of Hollis French, 210 South St., Boston, is engineer.

Crystal Falls, Mich. — Wisconsin-Michigan Power Co., Appleton, Wis., has approved plans for new hydroelectric generating plant at Crystal Falls, to cost close to $650,000 for power dam and hydroelectric generating station, exclusive of hydraulic-turbines, electric generators, and other equipment. Work on project will proceed at once. Mead & Hunt, 550 State St., Madison, Wis., are consulting engineers.

Detroit, Mich. — Fisher Body Division, General Motors Corp., St. Antoine Ave., automobile bodies, has approved plans for addition to power house at local plant. Work will proceed at once. Cost estimated about $125,000, exclusive of equipment.

Flint, Mich. — A-C Spark Plug Division, General Motors Corp., Flint, has approved plans for new power house at local plant, estimated to cost about $400,000. Work on superstructure will begin soon. Argonaut Realty Division, General Motors Research Bldg., Detroit, Mich., is engineer.

Joplin, Mo. — Vickers, Inc., 1400 Oakman Blvd., Detroit, Mich., hydraulic pumps, valves, fluid meters, etc., plans boiler house at proposed new plant on Schifferdecker Ave., Joplin, where large tract of land has been secured. It will comprise a main one-story building for general production service, and several auxiliary units. Entire project will represent a reported investment of about $3,000,000. Work is scheduled to begin at once.

Missouri City, Mo. — Northwest Electric Power Co-operative, Inc., Cameron, Mo., F. A. Martz, general superintendent, has plans maturing for new steam-electric generating plant on 50-acre tract of land near Missouri City. Cost reported about $8,000,000, with turbine-generators, high-pressure boilers, and auxiliary equipment.

Rochester, N. Y. — Rochester Gas & Electric Corp., 89 East Ave., will expend about $24,000,000 during 1952 and 1953, for expansion and improvements in generating station, power substations, transmission lines, and distribution system. Increased generating capacity will be carried out.

Newark, N. J. — Public Service Electric & Gas Co., Public Service Terminal, will soon begin work on expansion in steam-electric generating station at Burlington, N. J., with installation of new 185,000-kw generator and auxiliary equipment. Also, will proceed with further expansion at power plant at Kearny, N. J., where new 145,000-kw turbine-generator and accessory equipment will be installed. Company will expend about $25,000,000 during present year on these and other projects, of which amount approximately $2,000,000 will be used for extensions and improvements in other generating stations.

Cleveland, Ohio — Cleveland Electric Illuminating Co., Illuminating Bldg., has arranged a budget of about $30,000,000 for expansion and improvements in plants and system during 1952, including increased generating capacity, power substations, transmission lines, and other operating facilities.

Portland, Ore. — Portland General Electric Co., 621 S. W. Alder St., has received permission from Defense Production Administration, Washington, D. C., to proceed with proposed hydroelectric power project on Deschutes River, in eastern part of State. Project will consist of power dam, hydroelectric generating station, with rated output of 120,000-kw, artificial lake, power substations, transmission lines, and other operating facilities. It will be known as Pelton Station, and is estimated to cost $23,000,000. It is proposed to have plant ready for service late in 1953.

Providence, R. I. — Narragansett Electric Co., 51 Westminster St., has approved plans for expansion in local South St. steam-electric generating plant, including new multi-story addition and installation of turbine-generator, high-pressure boilers, and auxiliary equipment. Improvements will be made in present plant. Entire project is reported to cost about $20,000,000. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa., is engineer.

Knoxville, Tenn. — Tennessee Valley Authority, New Sprankle Bldg., is arranging plans for expansion in steam-electric generating plants, during fiscal year 1952, beginning July 1, including two additional turbine-generator units at Kingston Station, with high-pressure boilers and auxiliaries, estimated to cost $15,000,000; and for four additional generating units, with high-pressure boilers and accessories at Shawnee power plant, estimated at $28,000,000. At Colbert steam-generating station, it is proposed to install two additional turbine-generators to cost approximately $16,000,000.

Gainesville, Tex. — Texas Power & Light Co., Interurban Bldg., Dallas, Tex., has plans under way for new steam-electric generating station at River Crest, near Gainesville, to be equipped for a capacity of about 80,000-kw. Cost reported close to $6,000,000, with power substations, transmission lines and other operating facilities.

Every User of Heat Insulation Can Profit From This New Book

WRITE FOR YOUR COPY

This useful book, replete with pictures, graphs and charts, contains specific information on Kaylo Heat Insulation, including characteristics . . . efficiencies . . . recommended thicknesses . . . and application data for pipes, vessels and flat surfaces. For your free copy of this book, write: Dept. N-282, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

Kaylo Heat Insulation is a hydrous calcium silicate—the heat-saving material that is revolutionizing insulation practice with its outstanding combination of advantages.

KAYLO . . . *first in calcium silicate*

. . . *pioneered by* OWENS ILLINOIS **Glass Company**

MAIN OFFICE: TOLEDO 1, OHIO — KAYLO SALES OFFICES: ATLANTA • BOSTON • CHICAGO • CINCINNATI • CLEVELAND • DETROIT HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

"Make-Up Oil Cut 19%"

— says Deltox Rug Co., Oshkosh, Wis.

SINCLAIR OILS

Fine, smartly-designed fibre rugs made by the Deltox Rug Company are favorites with budget-wise consumers from coast to coast. The Deltox plant, in Oshkosh, Wis., generates its power with an Ames 4 cyl. Uniflow Steam Engine, shown here.

At first, this engine was giving Deltox engineers trouble with sludging and oil emulsification in the circulating system. Then, about a year ago, Deltox changed to Sinclair RUBILENE® Oil Medium. The gauge glass was watched vigilantly, but there was no evidence of emulsification or developing sludge.

Besides ending emulsification and sludging, the subsequent yearly overhaul showed practically no valve cam or bearing wear; and carbon deposits in the valve gearing were negligible. Furthermore, a check of past records showed a cut of 19% in make-up oil.

MAKING A CHECK. Sinclair Rubilene shows complete separation from water.

Are you getting full satisfaction from the circulating systems in your plant? Perhaps a Sinclair Engineer can save you maintenance and operating expense. Get in touch with your nearest Sinclair Representative, or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

for circulating systems

YARWAY REMOTE LIQUID LEVEL INDICATOR

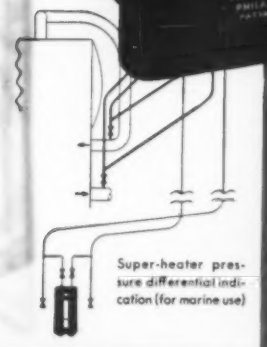
How many applications fit your plant needs?

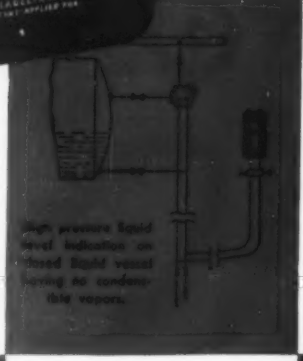
Versatility is the keynote of the Yarway Remote Liquid Level Indicator . . . lending to a variety of installation possibilities in any plant.

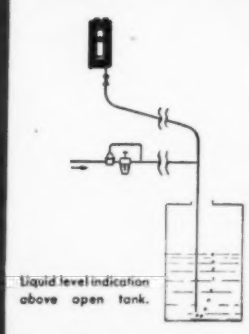
Wherever it's used, instant accurate level indication is always assured because the Yarway Indicator is operated by the liquid itself—by the pressure differential between constant head and the varying head. Magnetic transmission. No stuffing boxes.

Write for Bulletin WG-1833, or Bulletin WG-1830 on the *Recording* Indicator for the same applications.

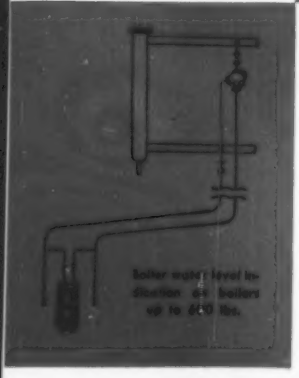
YARNALL-WARING COMPANY
114 Mermaid Avenue • Philadelphia 18, Penna.
PRINCIPAL CITIES

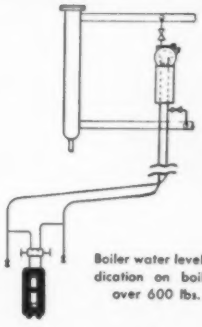

Super-heater pressure differential indication (for marine use)


High pressure liquid level indication on closed liquid vessel having no condensible vapors.

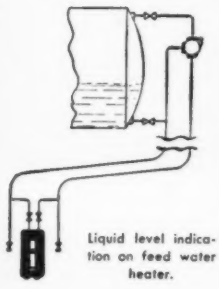

Liquid level indication above open tank.

Liquid level indication on elevated tank


Boiler water level indication on boilers up to 600 lbs.


Boiler water level indication on boilers over 600 lbs.

Outdoor liquid level indication.


Liquid level indication on feed water heater.

YARWAY REMOTE LIQUID LEVEL INDICATOR

LETTERS TO THE EDITORS

PUMPED STORAGE

Editor's Note:—Hundreds of readers have written us for copies of the outstanding article Pumped Storage Hydroelectric Power by Charles H. Spink. A condensation of it was published in the October 1951 issue; the complete paper is available as a 12-page reprint. Besides the copies requested by readers, we have sent several hundred additional copies to leading utility and industrial engineers.

We felt, of course, that this paper by Mr. Spink, giving engineering details and methods of figuring costs of pumped storage under today's conditions, especially when using the recently developed reversible pump turbine, would be worth study to see where and how it might fit. Naturally we did not expect that every reader could use the information immediately. But here are two recent letters showing more than mere general interest.

Here are two engineers who are actually planning specific pumped storage developments. Another very important installation using a 2-speed pump turbine is now under construction in Colorado and others are under development in the Southwest.

However, the following from a leading manufacturer should be of particular interest to readers. Remember that Mr. Spink's article showed how pumped storage could be of value to industries as well as to power utilities.

Industrial Power Engineer Studies Pumped Storage

I HAVE INDEED found your paper Pumped Storage Hydroelectric Power very interesting and I am at present surveying a direct application to our power problems. When I have completed my survey and calculations I shall be happy to send you a copy. Since I received your article, I have been poring over its contents and using it as a guide for my survey.

I cannot at the present time give any further comments on the article, but I can say that it came at a very opportune time and will be put to good use.

I am enclosing a copy of an analysis made of our plant load, which extends over three weeks. The accompanying drawing shows one week's load curve; the other two weeks' curves follows exactly same shape. It is with this load in mind, which will form the basis for my calculations, that I have found your article most interesting.

Chicago, Ill. T.M.T.
Power Engineer
(Machinery manufacturing company)

Consulting Engineer Will Plan Pumped Storage

I AM GREATLY involved in other important work but shortly will be able to consider pumped storage for a proposed hydro development in the State of ————. At that time I will be able to give you the results of our economic studies, employing reversible pump turbines. Assuring you of my interest in the matter, I remain

New York O.C.L.
(Consulting Engineer)

NEOPRENE FOR CONDENSERS

WE READ with interest an item in the Practical Engineer section of the October 1951 POWER ENGINEERING concerning the use of spray-applied Neoprene for controlling inlet and erosion of condenser tubes.

We have many condensers in our oil refineries and have experienced considerable difficulty with this type of failure. We would like to know how satisfactory the Neoprene treatment proves in service and would greatly appreciate your forwarding to us any such information when it becomes available.

California C. J. G.

Comments by Williamson

THE RUBBER coating of condenser tube ends and tube sheets in our opinion and experience, is definitely a highly promising method for protection against erosion in service up to 250 F. In steam plant practice water velocities of six to nine fps in condenser tubes are common. This means that there is considerable turbulence at the inlet end for six to 10 in. If the water contains silt, erosion follows. We have replaced as much as 100,000 lb of Admiralty brass tubes in a single condenser with 95% of the tube intact but with erosion at the inlet end cutting through the tubes. Needless to say this is a heavy expense.

It has been realized for many years that rubber coatings were extremely effective against abrasion if the coating could be made to stick. That, apparently, is the answer to the success we are having. It adheres very well indeed.

The new method calls for great care in sandblasting the surface and wire-brushing the tube ends. Then, without delay, two primer coats are sprayed on the surface, and after that 10 to 20 coats of Neoprene. About two weeks were required to so protect a condenser with 13,000 tubes, and the total labor and material cost was about 40 cents per tube.

The rubber coatings penetrate 10 to 15-in. into the tube, but feather out in thickness so as not to give a pronounced ledge that will cause local turbulence. That is one of the chief disadvantages to metal or plastic inserts — accelerated erosion takes place at their end.

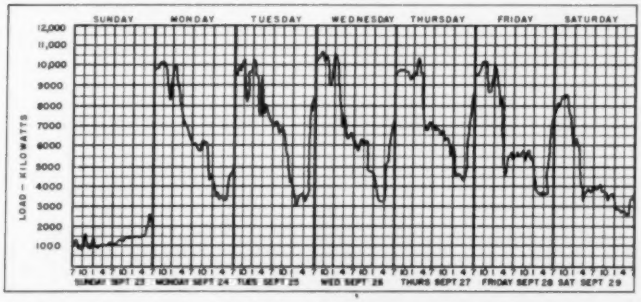
Not only is the Neoprene coating extremely promising for tube protection, but it is proving highly effective on impellers of pumps which handle abrasive liquids, such as Mississippi river water or ash slurries.

The material we use is prepared by the Synco Corporation, Emmaus, Pa. The Synco Corporation is quite insistent that, for best results with their product, one should take advantage of their surface preparation know-how.

In California (e.g. Southern California Edison Company) and on the East coast, the Neoprene spray method has also been successful in protecting condenser tubes from salt water corrosion.

St. Louis, Mo. G. V. WILLIAMSON

Editor's Note:—This is typical of the interest aroused by this process. Because the original article was based on data from Union Electric Co., we asked that company for further information. The foregoing from G. V. Williamson of Union Electric Co., used with his permission, should give further valuable help to engineers facing condenser tube end troubles.



Typical power demand curve in industrial plant of T.M.T., for one week. Complete record for three successive weeks shows essentially same curve shapes each week

BOUQUET

YOUR February 1952 article, What to Do About Oil in Boiler Feedwater, was very interesting. Right now we have a project under way in which the presence of oil in boiler feedwater is of considerable significance and we are having difficulty in impressing the management of the client with the hazards involved. We are distributing copies of this article to the management.

Pennsylvania N.C.S.
(Consulting Engineer)

New Recovery Boiler Features Wet-Bottom Precipitator . . .

By HARRY W. VANCE
Project Manager
The Rust Engineering Company

New installation at Clarion Mill of New York & Pennsylvania Co. at Jchnsonburg, Penna. . . . Single recovery unit has capacity of 84,500 lb per hr of 175-psi steam, burning black liquor from soda mill. . . . Feature is wet-bottom electrostatic precipitator, a new development and first installation in a soda mill. . . . Steam air heater for combustion air. . . . Unit recovers chemicals, burns soda black liquor, generates steam, decreases river pollution

Fig. 1. Soda process recovery steam generating plant is housed in this separate building for the New York and Pennsylvania Co. at Johnsonburg, Pa.

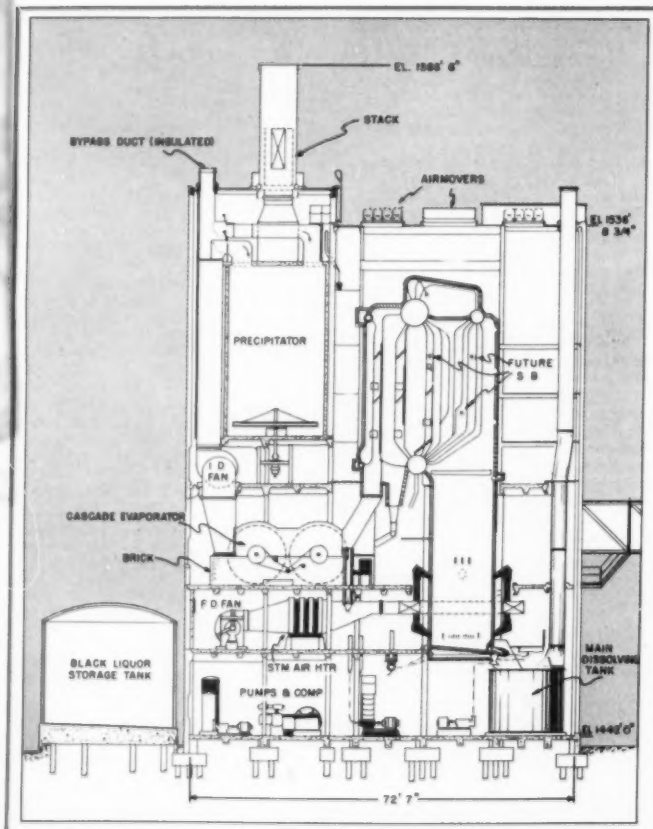


Fig. 2. General cross-section through recovery steam generating unit, wet bottom electric precipitator and auxiliaries at plant of New York and Pennsylvania Co. Details of precipitator courtesy of Research Corp., general drawing by The Rust Engineering Co.

A NEW 150-ton soda recovery boiler was placed in operation December 15, 1950 at the New York & Pennsylvania Co., Inc. Clarion Mill at Johnsonburg, Penna. The new unit will burn black liquor from the soda mill and, in addition to the burning of combustibles in the black liquor and the recovery of chemicals used in the cooking process, will generate 84,500 lb of steam per hour.

Designed and constructed by The Rust Engineering Co., of Pittsburgh, Penna., the new plant incorporates the most modern equipment available, and replaces coal-fired rotary black liquor burners. The completion of this unit with its efficient operation is another step toward the elimination of pollution in the Clarion River.

Construction of the new plant was accomplished in the elapsed time of 300 days. It is housed in a steel frame building 74 ft long by 42 ft deep and 100 ft high, with red brick and buff glazed tile walls, seven floors of concrete and grating, and a built-up asphalt roof on precast concrete roof deck.

Toilet room and locker facilities are provided for the operating personnel, and the building is provided with a completely enclosed stair tower and freight elevator, together with enclosed rooms for motor controls and precipitator electric equipment.

To support the weight of the building and equipment, steel tube piling was driven into the shale and filled with concrete. Since the plant is on the bank of East Branch of the Clarion River, sheet steel piling was driven into the shale and anchored into the pile caps on the river side to prevent erosion.

The recovery unit is a 3-drum, waterwall boiler and furnace with

economizer, operated at 175 psi, and is designed for a superheater and operation at 450 psi, 725 F in the future.

New Recovery Boiler

The boiler has a capacity of 84,500 lb per hr of steam at 175 psi saturated, and 73,200 lb per hr of steam under the future conditions burning 19,625 lb of dry solids, or 3371 gal of 53 per cent D.S. black liquor per hour. Black liquor is thickened to a suitable density for burning by a two-wheel cascade-type evaporator, using the flue gases from the boiler for this purpose.

The furnace section of the recovery unit is 14 ft wide and 11 ft-6 in. deep, and has volume of 5800 cu ft. The chemical is recovered as a smelt on the bottom of the furnace and runs off into a dissolving tank, where it is mixed with weak green liquor and when it reaches the proper density, returned to the paper mill for further use. Air to support combustion is provided by a forced-draft fan and is heated by steam air heaters.

Wet-bottom Precipitator A New Development

Flue gases from the boiler, after passing through the evaporator, are drawn through by an induced-draft fan having a variable speed drive, after which they flow through a Cottrell electric precipitator in which 90 per cent of the chemical dust is recovered from the gases before exhausting them to the atmosphere.

The feature of the precipitator is the use of a wet bottom, wherein dust collected falls into approximately 12 in. depth of liquor and is dissolved or carried in suspension. The liquor in the wet bottom is circulated by a motor-driven, blade-type agitator to facilitate solution and prevent the building up of solids in the bottom, and is continuously delivered to the smelt tank.

The wet-bottom precipitator is a new development and at this date is the third installation completed and in use in the paper industry. It is the first installation of this type in a soda mill.

Black liquor is received, at 53 per cent dry solids, from the existing multiple-effect evaporators at the mill in a combination storage tank and dump tank of approximately 70,000 gal capacity. Liquor is pumped from this tank to the cascade evaporator and, after concentration, is heated and pumped to the furnace spray nozzles. The storage tank will be operated at a level to allow sufficient capacity for dumping the black liquor contained in the cascade evaporator. Any spillage of liquors in the building is collected in a sump and pumped back to a weak black liquor storage tank in the mill.

The smelt-dissolving tank is agitated by air through a system of piping on the bottom of the tank, the air being supplied by an independent

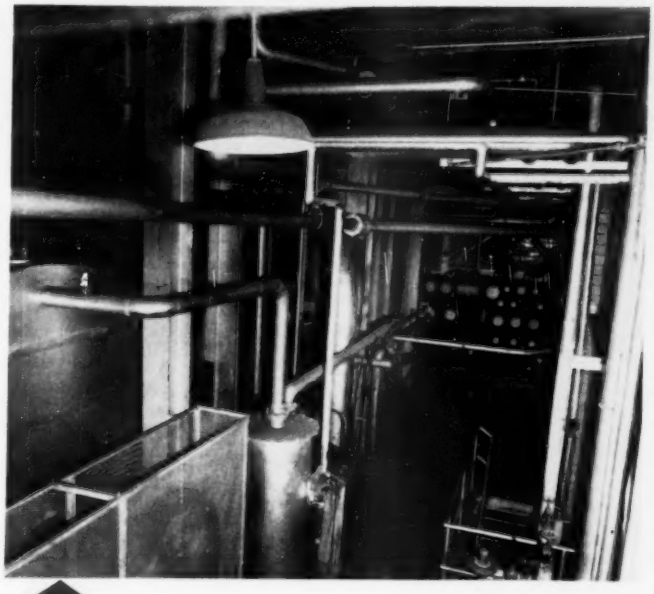
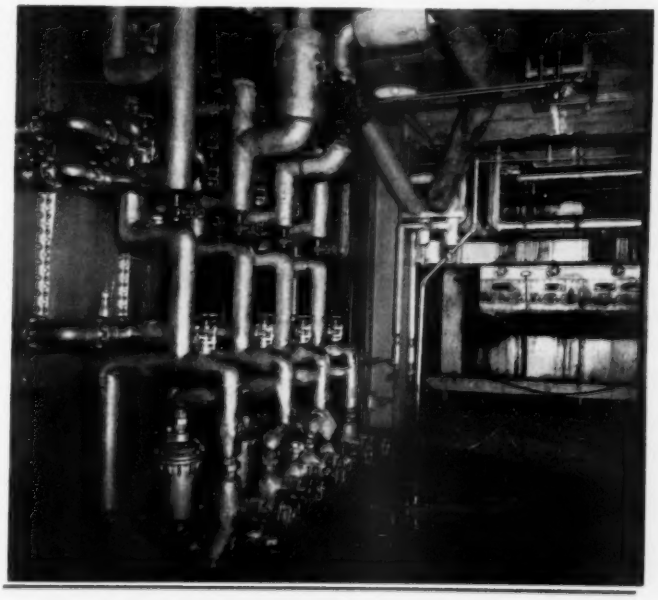


Fig. 3. Looking toward recovery boiler (center), on third floor, this view shows cascade evaporator (left). Boiler control panel in right background

Fig. 4. View on second floor, showing steam air heater at left, with recovery boiler in background



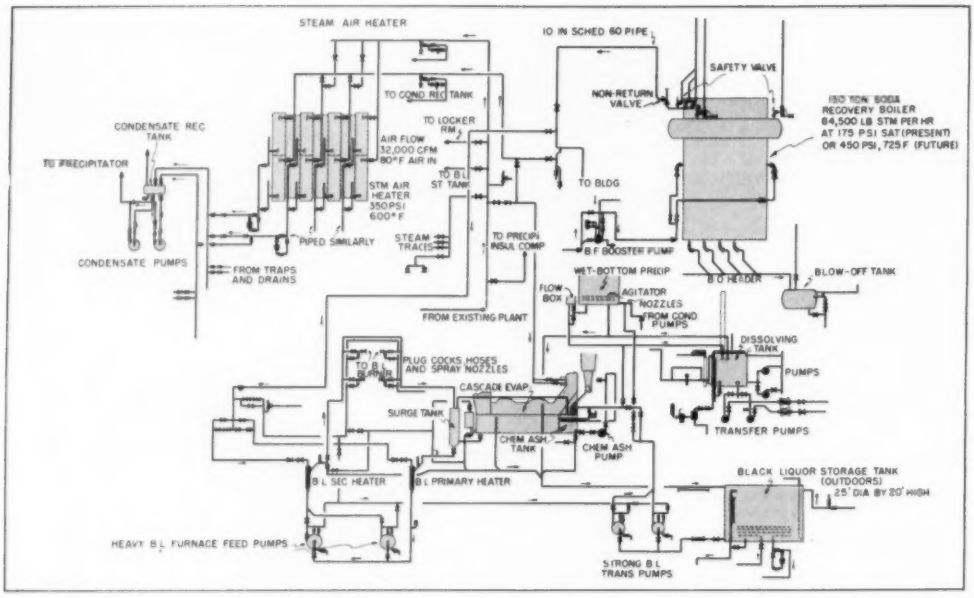


Fig. 5. Flow diagram of recovery boiler, precipitator and auxiliaries

air compressor. Further agitation is provided by circulating the liquor in the tank with a pump, which discharges into the smelt stream through a shatter spray nozzle.

Boiler feedwater is provided from the mill's existing feedwater treatment plant and additional head needed to feed the new boiler is provided by a booster pump. Feedwater to the boiler is regulated automatically through a Flowmatic type control valve. Cooling water used for auxiliary equipment is provided from the mill supply and also requires the use of a booster pump.

The boiler is equipped with air-puff soot blowers, using air for blowing and for control. A large compressor operating at 350 psi provides the air, and a controller governs the sequential operation of the individual blowers. Air connections are provided for hand lancing the boiler with 125 psi air.

Instrumentation

A well-arranged control panel is located on the operating floor, on which is mounted a 10-pointer draft gage, pressure gages for steam at drum and auxiliaries, feedwater, filtered water, green liquor, and black liquors, steam and air flow meters, recorders for air temperatures at the heaters, water-level indicator, liquor-level controllers and flow meter, and density controller for smelt tank.

In addition to the instruments, push-button stations are located on the panel and control all motor operated auxiliaries of the system. A separate compressor supplies air for instrumentation and for operating rapper mechanisms on the precipitator.

Ventilation

The building is ventilated by gravity air mover type ventilators located on the roof and a system of louvers in the walls, which can be adjusted to ventilate according to outdoor temperature conditions.

Other Facilities

In addition to the new recovery boiler house, a 300-ft long pipe bridge was designed and erected, connecting the existing mill with the new boiler house. This bridge carries the facilities for serving the new boiler house, which consist of steam, black liquor, green liquor, boiler feedwater, and cooling water lines, also electric feeder from power house to mill.

An enclosed loading dock approximately 600 ft long was constructed adjacent to the paper department buildings, replacing existing shipping facilities. This dock was constructed in three separate operations so as to interfere the least with operations.

Construction of the additional facilities was carried on at the same time as the recovery boiler house. The pipe bridge was completed in the elapsed time of 180 days. The first section of the loading dock was completed and in use after the elapsed time of 60 days, the second section in 40 days and the final section in 50 days.

Sub-Contractors

Main sub-contractors for the Rust Engineering Company during construction were: Warren-Ehret Co. — roofing and sheet metal. The General American Transportation Co. — tanks. Allegheny Industrial Electrical Co., Inc. — electrical work. Laco Applicators, Inc. — pipe and block insulation. Arthur Painting Co. — painting. Campbell Elevator Co. — freight elevator.

Principal Equipment New Recovery Unit New York & Pennsylvania Company

Recovery Boiler — Combustion Engineering-Superheater, Inc.
Cascade Evaporator — D. J. Murray Co.
Boiler Settings — The Rust Engineering Co.
Precipitator — Research Corp.
Soot Blowers — Vulcan Soot Blower Co.
I-D. Fan and Variable Speed Drive — American Blower Co.
Air Heater — American Blower Co.
F-D. Fan — F. F. Sturtevant Div., Westinghouse Electric Corp.
Soot Blower Compressor — Chicago-Pneumatic Tool Co.
Instrument Compressor — Chicago-Pneumatic Tool Co.
Smelt Tank Agitator Compressor — Nash Engineering Co.
Liquor and F. W. Booster Pumps — Worthington Pump & Mach. Co.
Chemical Ash Pump — Ingersoll-Rand Co.
Sump Pump and Water Booster Pump — Buffalo Pump Co.
Plate Work — Scottdale Foundry & Mach. Co.
Structural Steel — Pittsburgh Bridge & Iron Works
Brick and Glazed Tile — The Hanley Co.
Grating — Dravo Corp.
Motors — Reliance Elec. & Engr. Co.
Draft Gages and Flow Meters — Bailey Meter Co.
Liquor Level and Density Controls — Brown Instrument Division Minneapolis-Honeywell Reg. Co.
Liquor Level and Density Controls — The Foxboro Co.
Main Steam and Water Piping — The Rust Engineering Co. (fabricated on job)
Valves — Edward Valves, Inc.; Walworth Co.
Safety Valves — Consolidated (Manning, Maxwell & Moore, Inc.)
Boiler Blow-off Valves — Yarnall-Waring Co.
Steam Traps — Armstrong Machine Works
Condensate Pumps — Westco
Watercolumns (boiler) — Diamond Power Specialty Corp.
Pressure Gages — Ashcroft
Designers and Constructors — The Rust Engineering Co.

How To Select and Install Powerhouse Auxiliary Motors

One of the largest customers of any steam generating station is its own auxiliaries. Furthermore, no customer presents more exacting or more varied operating requirements; and nowhere is reliability more important. Consequently selection of powerhouse auxiliary motors is a subject with which all power engineers should be thoroughly familiar

By R. W. FERGUSON

Central Station Engineering, Westinghouse Electric Corporation, East Pittsburgh, Pa.

A COMPLETE description of the many and varied motor applications found in a modern steam station is almost a description of the station itself. Every phase of power generation requires some closely associated auxiliary equipment, which, in the modern power plant, is driven almost exclusively by electric motors. Indicative of the large number of motor applications in a modern steam station, a recent power plant comprising two 75,000-kw turbines required over 700 auxiliary motors. In a typical plant the auxiliaries consume approximately 6 per cent of the total power output and have a total horsepower rating of from 12 to 15 per cent of the kilowatt rating of the main turbine generators. The initial investment required for the auxiliary motors can amount to from $2.00 to $2.50 per kilowatt of turbine rating.

The diagram of a typical steam plant shown in Fig. 2 illustrates some of the duties performed by auxiliary motors. In addition to the motor applications shown, numerous special applications such as water and chemical pumps, elevators, and machine shop tools also require motor drives.

No two generating stations are identical. It is impossible to state exactly the motor sizes and types that will be present in a steam generating station of a particular size. The requirements are governed by such factors as type of fuel, heat cycle, source of water, and anticipated station loading cycle.

Approximate sizes of the major auxiliary motors are given later as percentages of the nominal rating of the turbine-generator unit. The figures are average values based on a survey of steam stations with turbine-generator units of 100 megawatts and below.

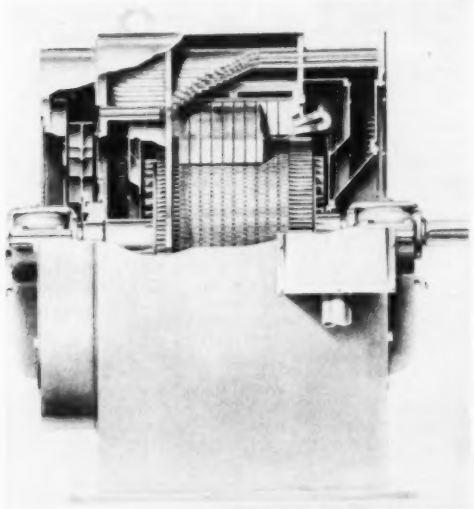


Fig. 1. This cutaway view of an outdoor type motor shows the constructional features that provide extra protection against the effects of weather

Characteristics of Powerhouse Auxiliary Motors

The primary characteristics to be considered in selecting auxiliary motors are size, speed, motor type, torque requirements, operating conditions, class of insulation, and type of enclosure. In addition, motors for central-station service must have special features that insure reliability and ease of operation, features such as special moisture-resistant insulation, adequate provision for oil-ring inspection on motors with sleeve bearings, easy accessibility of the bearings and windings for servicing and inspection, and adequate terminal boxes. The reliability, efficiency, and simplicity of installation and control of the squirrel-cage induction motor have made it the almost universal choice for powerhouse applications.

Powerhouse auxiliary motors range in size from less than one horsepower, used to open and close valves, to several thousand horsepower, used to pump water into the boiler. They usually have dripproof enclosures with class-A insulation, and are designed to have low starting current and normal starting torque. However, some auxiliaries require special

torque or speed characteristics, or present unusual service conditions such as excessive dirt, moisture, abrasive fly ash, or high temperature; or the plant may be an outdoor installation. Motors for such applications must have special characteristics to satisfy these requirements.

Pump Motors

Pumping is one of the major duties performed by powerhouse auxiliary equipment, and usually the largest motors in the station are those that drive the boiler-feed pumps. In a typical station the total horsepower rating of the boiler-feed-pump motors is between five and six per cent of the kilowatt rating of the associated turbine. At least two and usually three boiler-feed pumps of equal rating are used. These pumps operate against a very high head and require 3600-rpm drives.

The output of the boiler-feed pumps is controlled by throttling or by varying the speed of the pump. The latter method is attractive because of reduced operating cost. Variable-speed control, when used, is achieved with a variable-speed coupling or by using a wound-rotor motor and a liquid rheostat.

The torque requirements of boiler-feed pumps and most other pumps are satisfied by motors with low starting current and normal starting torque. Most boiler-feed-pump motors are rated for a temperature rise of 40 deg C above ambient and have class-A insulation. Where the ambient temperature is above 40 deg, class-B insulation is used.

Although dripproof construction is usual, special enclosures are sometimes used to reduce the noise level of the motor or to protect the motor from fly ash and other unfavorable atmospheric conditions. Noise can be reduced by using pipe- or base-ventilated motors in which the inlet and exhaust for cooling air are at a remote location. In particularly dirty locations enclosed motors are used. Air for such motors is cooled by either an air-to-air or an air-to-water heat exchanger. Since outside air is never drawn into the motor, the windings are protected from contamination.

Types of Motors Most Used on Powerhouse Auxiliaries

Type of Enclosure	Temperature Rise Above Ambient Degrees C	Ambient Temperature Degrees C	Class of Insulation	Service Factor
Drippproof	40	40 max.	A	15%
		41 to 50	A	None
		41 to 60	B	15%
		61 to 70	B	None
Splashproof	50	40 max.	A	None
		41 to 60	B	None
Totally-Enclosed Fan-Cooled	55	41 max.	A	None
		41 to 60	B	None
	75	40 max.	B	None

In addition to boiler-feed pumps, numerous other pumps are associated directly with the water cycle of the plant or perform auxiliary functions. These include pumps for handling circulating water, condensate, drain water, raw water, water-purification chemicals, ash, flood water, water for fire protection, sump water, lubricating oil, and station water supply. Usually the largest of these are the circulating-water pumps. In a typical station, there are two circulating-water pumps per turbine with a total horsepower slightly less than one per cent of the turbine rating. The remaining pumps range in size from a fraction of a horsepower for small chemical-feed pumps to 100 to 300 horsepower for some raw-water, ash, and fire pumps. The size of the driving motor in a particular application is determined by the head and capacity requirements, which are influenced by the nature of the water source.

The location, and the speed and torque requirements of these pumps usually allow the use of standard dripproof, squirrel-cage induction motors with low starting current and normal starting torque. Most pump motors have a synchronous speed of 1200, 1800 or 3600 rpm; however, some motors, such as the circulating-water pumps, may require speeds as low as 277 rpm. Vertical motors are frequently used for pumping service because they require much less floor space.

Air- and Coal-Handling Motors

Fans supplying air for combustion are usually driven by squirrel-cage motors. Where variable speed is desired for control and to reduce fan wear, wound-rotor induction motors or squirrel-cage induction motors with hydraulic or magnetic coupling are used. Frequently, two-speed squirrel-cage induction motors are used to take advantage of the reduced fan wear at the slower speed permissible during light-load periods.

In a typical station induced-draft fans have a total horsepower of 2.5 per cent of the turbine rating, while forced-draft fans have a total horsepower of approximately 1.2 per cent. Usually two forced-draft fans and two induced-draft fans are used per boiler. Forced- and induced-draft fans are often installed in locations with abnormally high ambient temperatures. For such applications the motors must have class-B insulation. With unfavorable atmospheric conditions,

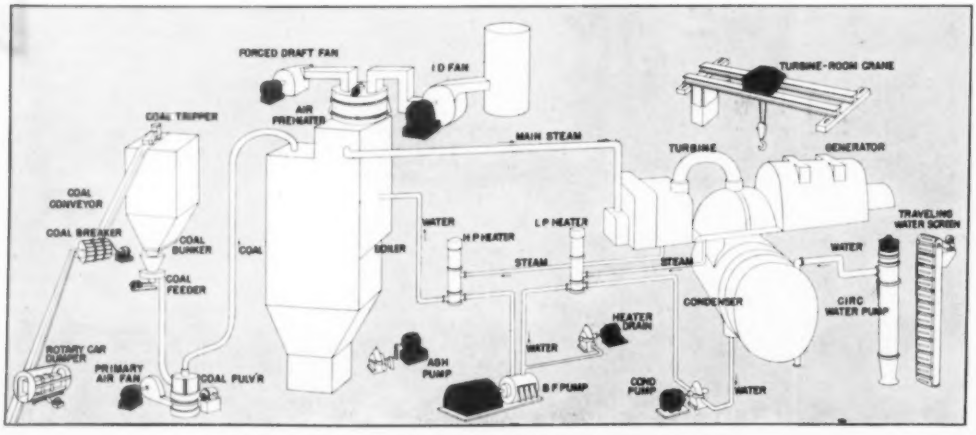


Fig. 2. Diagram showing the location of the principal powerhouse auxiliary motors

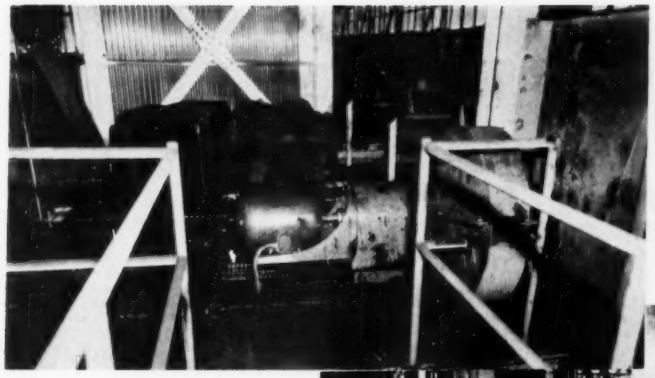


Fig. 3. (Left) A totally-enclosed fan-cooled motor driving a coal conveyor on the upper level of a power plant

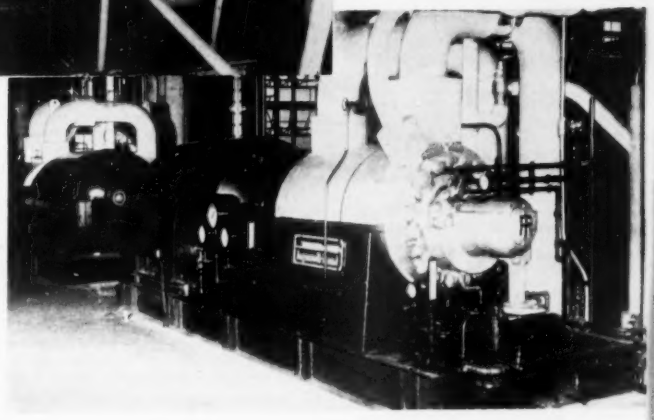


Fig. 4. (Below) Two 700-hp, 3600 rp·m, type CS motors driving the boiler-feed pumps in a large steam-electric generating station

totally-enclosed, fan-cooled motors are used for the fan drives.

Most stations using coal for fuel burn the coal in pulverized form. Pulverizers present the problem of a high-starting-torque, high-inertia load. The starting torque requirements vary with the type of pulverizer, the amount of moisture in the coal, and the duration of shutdowns. Motors are selected that can start the mill with favorable coal conditions after a momentary shutdown and have sufficient thermal capacity to allow two consecutive normal starts at full voltage. The motors are either high-torque or low-torque, dripproof, squirrel-cage induction motors with class-A insulation.

Motors driving coal-handling machinery are subjected to particularly severe operating conditions and must possess special characteristics. The areas in which they operate are dust and moisture laden; therefore, totally-enclosed or totally-enclosed fan-cooled motors are necessary. Some coal-handling auxiliaries require special torque characteristics. For example, coal-conveyor motors must have high starting torque. Other motors, such as coal-bridge motors, are rated for cyclic or short intermittent duty. Hoist motors with high starting torque and high slip are used for drag scrapers and similar coal-moving equipment. Gear motors are frequently used to satisfy the slow-speed requirements of conveyors.

Types of Motors for Powerhouse Applications

Motors for powerhouse auxiliaries are available in three standard constructions: dripproof, splashproof, and totally-enclosed fan-cooled. The correlation between type of enclosure, temperature rise, ambient temperature, and type of insulation is shown in the accompanying table. All motors rated for a temperature rise of 40 deg C will carry a 15 per cent overload continuously with a safe temperature rise when operating in an ambient temperature of 40 deg C.

In addition to the three standard enclosures, special ones are necessary for unusual operating conditions. These enclosures include self base-ventilated, self pipe-ventilated, forced-ventilated, explosionproof, and outdoor types. Self base- and pipe-ventilated motors are totally-enclosed and cooled by air circulated through ducts or pipe. The air intake and discharge are located in an area remote from the motor. This reduces the noise at the motor location and, where the air around the motor is dirty, makes it possible to obtain cleaner air from another location. Base-ventilated enclosures have openings at the floor line for connection of air ducts. Duct work to the source of air can then be installed underneath the floor if more space is available there. Pipe-ventilated motors have openings above the floor line.

There is a growing trend toward outdoor or semi-outdoor installation of new steam stations. Motors in such applications must be capable of providing reliable operation during all types of weather. A motor designed for outdoor service is shown in Fig 2.

This outdoor enclosure is also available for vertical motors. Again two inlet and two discharge openings are provided. These are alternately spaced at 90 deg intervals around the circumference of the motor. The inlet openings are at the top of the motor; the discharge openings are at the bottom. Low-velocity air passages are provided to remove entrained water and straight-through passages for winds of hurricane velocity.

Totally-enclosed, fan-cooled motors are especially applicable where large amounts of fly ash and dust are present, or in outdoor installations where salt spray is a problem. In the tube-type, totally-enclosed, fan-cooled motor, outside air is not used inside the motor for cooling. The internal air is cooled by a copper tube heat exchanger.

Motors for powerhouse auxiliary drives must meet a wide range of requirements. All motors must provide the maximum possible reliability even under severe operating conditions. To assure that this requirement is met, Westinghouse motors are earmarked for powerhouse auxiliary service and labeled as such from the time the order is received until they are shipped. Motors with this label are given special attention during manufacture, including special inspections and other precautions to insure reliability. In the larger sizes, motors with this label are automatically given special moisture-resistant insulation.

Motors for central-station use are frequently purchased by the manufacturer of the auxiliary equipment. To assure special treatment, it is essential that the manufacturer be notified that the motors are going into power plants. He will then carry out the procedures for this treatment.

Fig. 1. Malgovert Power House. Second phase of concreting of the walls of the valve room. (Photo, Villeurbannoms)

Power Construction Paces French Recovery

Few American power engineers probably are aware of the tremendous scope of power development in France since the end of the war in 1945. This development includes practically all of France's resources, thermal as well as hydroelectric. This brief description by Professor Whetstone indicates how thoroughly all aspects of France's power resources are being integrated into a truly comprehensive, long range plan for their development

By GEORGE A. WHETSTONE
Department of Civil Engineering
Texas Technological College, Lubbock, Texas

HOW has Europe recovered?

To a power engineer who has witnessed the impact on American generating capacity of the war and rearmament programs here and who has seen Grand Coulee, Bonneville, and other huge projects pass from attack only a few years ago on the charge that their production could never find a market, to their present inadequacy; the answer to this question must be stated in units of kilowatts.

Consider France in 1945. Five years of occupation had left her with many of her power plants destroyed by the enemy, and most of the rest of them in poor repair due to ineffective maintenance and normal obsolescence. On the other hand the demand included the heavy requirements for rehabilitation in addition to the normal load. It is no exaggeration to say that on the ability to produce and deliver power rested the stability of the nation and, in large measure, the peace of the world.

The situation called for a short-range program of restoring damaged plants and getting kilowatt-hour production with little regard for cost, and a long-range (actually 1946–1951) program designed to yield an interconnected system of steam and hydro plants of good efficiency and adequate to meet the anticipated demands. Moreover, this system must be in harmony with the natural resources of the nation. France, it should be remembered, is relatively poor in coal and nearly lacking in petroleum, but she has some of the world's finest hydroelectric potentialities.

To understand a little better the "building blocks" with which French engineers were to construct the power system we may classify the steam and hydro plants on the bases of fuel types and hydrologic regimes as follows:

a. Mining plants. These are steam plants located in the coal fields and designed to burn low-grade coal which would otherwise be useless, Their output was to be increased by increasing mining and by a program of re-equipping to secure the much better efficiencies of modern steam plants.

b. Blast furnace plants. These are steam plants located at the steel mills and operated by waste gases. Their economics is similar to that of the mining plants.

c. Steam plants of *regularization*. These are plants burning commercial grade coal. Located usually in a metropolitan area, they are necessary as protection against stream flow deficiency and against transmission line failures, but in the French economy should be used as little as possible.

d. Hydro of Alpine or glacial regime. Precipitation in the power producing regions of Southern France tends to be concentrated largely in the winter. In the high watersheds of the Alps this occurs mostly as snow and has resulted in many square miles of glaciers. The runoff is thus

high in the late spring and summer, but very slight in the winter when the power demands are greatest. On the other hand, a glacial regime is only slightly affected by wet or dry years, since a hot dry summer accelerates the ice melt and tends to compensate for the runoff usually provided by rain. To secure the maximum benefit from such a regime seasonal storage is necessary.

e. Hydro of snow-melt regime. A similar set of hydrologic conditions exists in the Pyrenees, except that there are no glaciers here. This is a region of many ingenious diversions and pumped-storage schemes.

f. Hydro of pluvial regime. In the Massif Central, a mountainous mass in South Central France attaining about 6000 ft of elevation, runoff occurs in direct response to the fall and winter rains. This regime thus corresponds ideally to the load distribution, but is rather too sensitive to dry years.

g. Hydro plants on the Rhone and Rhine. These great rivers, due to the diversity of their basins, have excellent sustained flow characteristics. The Rhone, in particular, is undergoing intensive development.

The plan adopted called for the productions indicated in Table II, where the hydro power in kilowatt-hours was based on the assumption of normal rainfall. Table I gives the production and consumption for 1938–1945 for comparison. The map, Fig. 2, shows the regional distribution of produced power at the end of the present construction program.

A list of the plants completed or put under construction since the war with the data on their equipment would reveal the great diversity employed. If we were also to indicate their design load curves, the skillful blending of the divers hydraulic regimes with the by-product steam outputs (the mining and blast furnace plants) could be appreciated after a statistical analysis.

But such a list would be long. Its very bulk would obscure the philosophy of planning and the ingenuity of conception. Thus we shall discuss only a typical scheme for each of the hydrologic provinces and let the totals in Table II and the dots in Fig. 2 convey to the reader the magnitude of the total plan.

The French Alps

The origins of hydraulic power with direct applications of the forces are lost in antiquity, but hydro-*electric* power involving transmission at some distance was "born" in 1888 at La Roche-sur-Foron in the Alps.

Here also is located Grenoble with its great turbine and penstock factories, with the world-famous Laboratoire Dauphinois d'Hydraulique and l'Ecole Nationale Superieure d'Electrotechnique et d'Hydraulique.

A glance at the dots on Fig. 3 would seem to indicate that surely here hydro development has reached its economic limits of completion. Yet, actually, the Isere River basin, which is the part of the French Alps shown in Fig. 3, is regarded as a great undeveloped power source.

The explanation of the paradox lies in storage. The natural stream flow varies in such a way that high water in July is usually about ten times the discharge of low water in January and February. Thus much of the potential ten billion kilowatt-hours annually of the Isere flows to waste and the seasonal distribution of that produced is out of phase with national requirements.

About 20 years ago a start was made on the storage problem by the construction of three dams including Chambon, then the highest dam in Europe, and Sautet, an arch dam in a gorge so narrow that one cubic meter of concrete holds 2100 cubic meters of water and corresponds to 2400 kwh per yr. But these dams were on tributaries and, while impressive in an absolute sense, they held only a minor fraction of the flow.

Table I. French Power Consumption 1938–1945. (Billions of kwh)

	1938	1939	1940	1941	1942	1943	1944	1945
Hydro power	10.40	12.30	11.95	12.40	10.60	11.40	9.20	10.30
Thermal power	10.40	9.80	6.85	8.00	9.55	9.80	6.90	8.20
Balance of foreign exchanges	+0.30	+0.20	+0.30	+0.50	+0.25	−0.10	−0.10	+0.60
TOTAL (Consumption and line losses)	21.10	22.30	19.10	20.90	20.40	21.10	16.00	19.10

Table II. French Power Objectives Under the Plan for 1946–1951. (Billions of kwh)

	1946	1947	1948	1949	1950	1951
Hydro power planned	13.000					24.000
Thermal power planned	12.000					15.500
TOTAL planned	25.000	27.300	30.900	33.500	37.200	39.500
Percentage of normal runoff	0.85	0.90	0.93			
Hydro power produced	11.331	12.967	14.801			
Thermal power produced	11.628	12.974	14.182			
Balance of foreign exchanges	+1.437	+1.086	+1.075			
TOTAL (Consumption and line losses).	24.396	27.027	30.058			

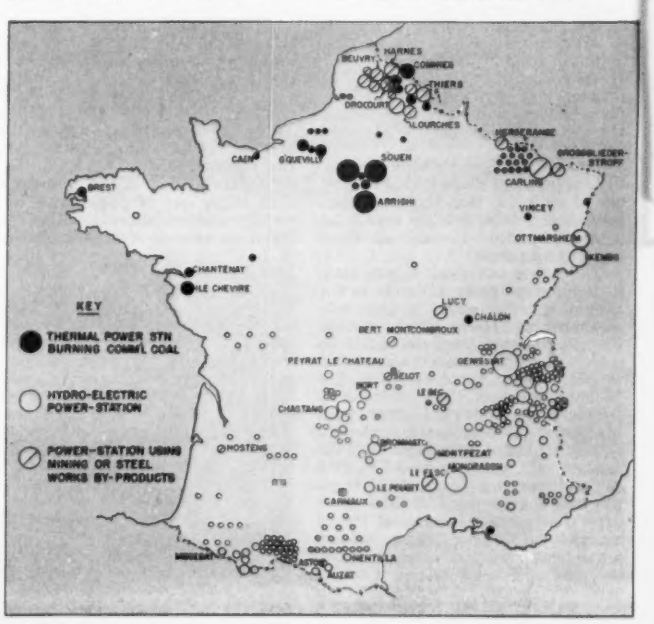


Fig. 2. Regional distribution of produced power at the end of present construction program. Those power plants whose production in an average year exceeds 100 million kwh are shown by circles of areas in proportion to their production

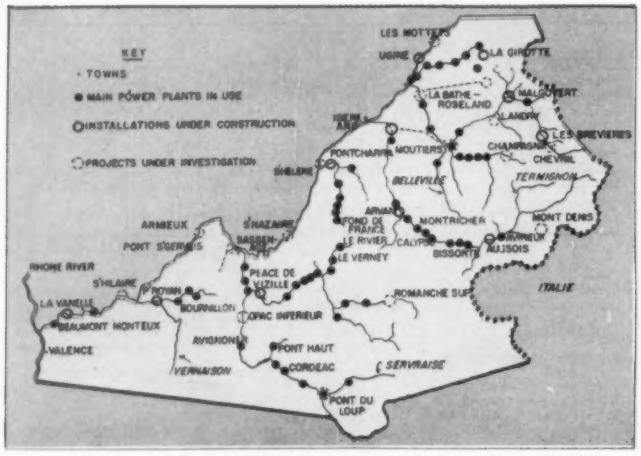


Fig. 3. Power development of the Isere Basin

Another interesting early development consisted in the driving of a tunnel into the lake of Girotte 262 ft below normal water surface creating a storage of 20,000 acre-ft. In 1948 the volume of this reservoir was raised another 20,000 acre-ft by completion of a *row of bottles* dam about 100 ft high built on the narrow ledge of rock through which the tunnel had been driven. Plans now exist for raising the dam another 36 ft by some applications of pre-stressed concrete.

Longer-range plans call for the virtually complete utilization of the resources of the Isere. At present Tignes Dam, setting a new European record height of 525 ft, is nearing completion across the headwaters. This will store 191,000 acre-ft above an elevation of 5600 ft allowing its ultimate development in plant after plant down the Isere and Rhone through more than 5000 ft of useful fall.

Three more reservoirs in the advanced planning stage in this vicinity are of such size that the four reservoir total will be 800,000 acre-ft or, considering the elevations, three billion kwh per yr.

The power outlet of Tignes Dam is designed to carry 1760 cfs to the Brevieres plant about a half mile downstream. Here three vertical Francis turbines rated at 42,200 hp each will work under heads of 318 to 765 ft. The annual output will be 156 million kwh. The tailrace of Brevieres flows to the forebay of Malgovert. Two cable-wrapped reinforced expanded penstocks with diameters of 7 ft, 2.5 in. and 6 ft, 10.5 in. will carry a total of 1590 cfs through a gross head of 2460 ft to drive four double overhung Pelton units (two runners per generator) having an output of 103,400 hp per unit. The annual production will be 680 million kwh.

Future plans call for two more plants on the Isere downstream from Malgovert. All pre-existing plants will be by-passed and modified to operate on the waters of tributaries only. The Moutiers plant will develop a 1080-ft head for 170,000 kva and 420 million kwh per year. Below this, the Isere-Arc diversion project which carries the Isere through a tunnel to the valley of its tributary, the Arc, will develop 130,000 kva and 477 million kwh per year on a 502-ft head. Below Isere-Arc a thousand feet of head remain to be developed by plants, some existing, some in construction, and others under investigation on the Lower Isere and the Lower Rhone.

The Pyrenees

The Pyrenees Mountains, on the Spanish border, share with the Alps the disadvantage of having a very light natural flow in the winter and thus being out of phase with load requirements. Unlike the Alps, the Pyrenees have no storage in glaciers. On the other side of the ledger, there are many high concentrated falls and some good natural dam sites. France's highest head plant (Portillon, 3593-ft head, single 40,000 kw unit) is here.

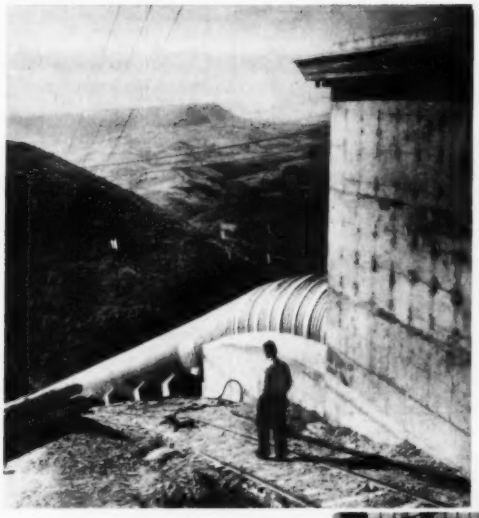
An effective reservoir for seasonal storage for power must have two essential characteristics: elevation and water. When these do not coincide, as is often the case in high installations, it may still prove worthwhile to dam a high basin and divert neighboring streams to it by gravity if possible or by pumping if necessary. This type of development together with a chain of plants down the valley has been typical of the Pyrenees for a quarter century.

Thus[1] on the Ossau River the Lake of Artouste was developed into a reservoir of 18,600 acre-ft capacity despite the fact that the average annual flow of its natural basin is but 8100 acre-ft. Supplementary water is obtained by diversions from five neighboring basins, four of which drain into a canal. By means of gates this canal can feed directly into a penstock leading to the Artouste power plant or into a pumping plant where the water can be lifted up to 250 ft into the lake. From the lake, water is utilized through the three plants of Artouste, Miegebat, and Hourat for a total head of 4250 ft. The tailrace of Hourat has an elevation in excess of 1700 ft part of which is utilized at the post-war plant of St. Cricq. Still another plant is under construction downstream from St. Cricq.

The largest development in the Pyrenees is that of Cap de Long — Pragneres scheduled for completion in 1953. The heart of this project is a dam at Cap de Long 330 ft high which will store 50,000 acre-ft of water above 7000 ft in elevation. The water supply for this reservoir, as for Artouste earlier, is obtained by natural inflow, by gravity diversion, and by pumping from water courses too low to be diverted by gravity. The reservoir outflow, in turn, is

[1] LeClerc du Sablon. Les Stations de Pompage en Montagne. Mem. Soc. Ing. Civil de France 1932, p 707–717.

Fig. 4. Tignes Dam, now nearing completion across the headwaters of the Isere River. This will set a new European record for height. (Photo, Baranger)



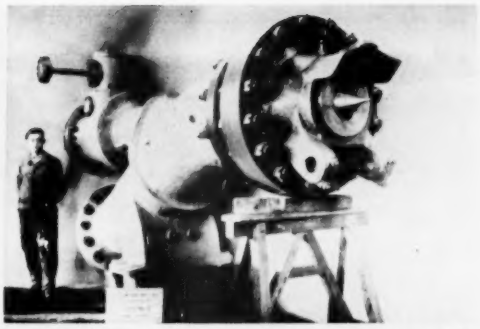


Fig. 5 (Above). Bissorte turbine injector. This injector is used on one of the three single-jet Pelton turbines constructed for the Bissorte plant (Maurienne, French Alps). When built in 1936, these jets were the most powerful in the world—34,200 hp for a diameter of 6½ in. Head, 3710 ft.

Fig. 6 (Left). Penstock for Le Pouget Power Plant in the Massif Central. Head, 1500 ft; discharge, 1060 cfs; power, 160,000 hp (present French record). Completed in 1951. (Photo, Bouchayer et Viallet)

diverted from its natural basin to an adjacent basin where a head of 3940 ft can be obtained at the Pragneres Power Station. This will be utilized by two 80,000 kw Pelton units. The net power output after deducting power used in pumping, but including the increase in power at downstream stations due to better regulation of flow has been estimated at somewhat over 300 million kwh annually.

The Massif Central

Natural flow in the rivers of the Massif Central is in excellent phase with national power requirements. With interconnection, the regime is complemented by those of the Alps and Pyrenees to provide considerable firm power. But "considerable" is not enough. Here again, seasonal storage is the key to today's redevelopment.

As a good example of the thoroughness with which French development is being pursued, consider the Dordogne Valley, a map of which appears in Fig. 8. The river rises at an elevation of 6190 ft and then flows in deep canyons for 89 miles to its junction with the Maronne. Four great dams on the main course of the Dordogne create a series of reservoirs, the lower three of which reach nearly to the dam above. The most upstream dam of the series, Bort, now under construction, will provide head-of-the-valley storage in a reservoir of 380,000 acre-ft capacity.

The Bort powerhouse will contain three turbines. Two of these are 136,000 hp vertical Francis wheels operated by reservoir water at heads up to 370 ft. The other is in a diversion of water from the tailrace of the Coindre plant on the Rhue River and will discharge under back pressure on its draft tube into the Bort reservoir. This diversion, designed for a peak flow of 2500 cfs, is made by means of a 102 ft high arch dam and a 14 ft-9 in. dia tunnel 7¾ miles long. An overflow surge tank at the head of the penstock has a direct channel for leading spilled water to Bort Reservoir.

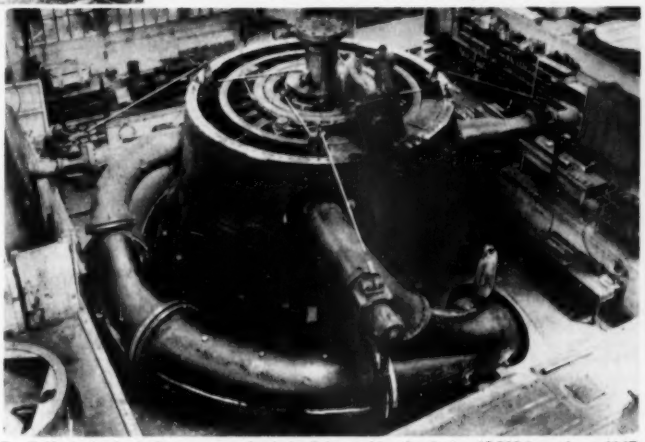


Fig. 7. Vertical axis, single runner, quadruple jet Pelton turbine developing 45,800 hp under a 1217 ft head at 350 rpm being assembled in the Neyrpic shops. Note needle synchronizing rods and deflector synchronizing cams

Downstream of Bort on the shore of Mareges Reservoir is the Val Beneyte plant operated on impounded waters of the Diege River together with a flow of 194 cfs diverted from the Artaude River by a 3030 ft tunnel (see inset, upper left of Fig. 8). The reservoir on the Diege supplying Val Beneyte also serves as tailrace for the La Bessette plant.

The third main reservoir coming downstream is that of l'Aigle. As may be seen in the middle inset on the right of Fig. 8, the l'Aigle reservoir has had its volume augmented by a diversion tunnel nearly on level grade intersecting the Luzege River behind a dam. This tunnel also serves to divert the Aubre by means of an intake well. Some statistics are given in the inset.

The Marcillac plant on the shore of Chastang reservoir is again supplied by an ingenious diversion system, the details of which appear on the lower right inset of Fig. 8.

At least five more sites downstream of Chastang and two upstream of Bort on the Dordogne itself, as well as several more plants on tributaries are now under active study.

Upon completion of the present development program on the Dordogne and its tributaries the ten largest power plants will have a total installed capacity of 950,000 kva. In terms of annual output this amounts to 2,211,000,000 kwh. The value of the reservoir storage will be 391 million kwh.

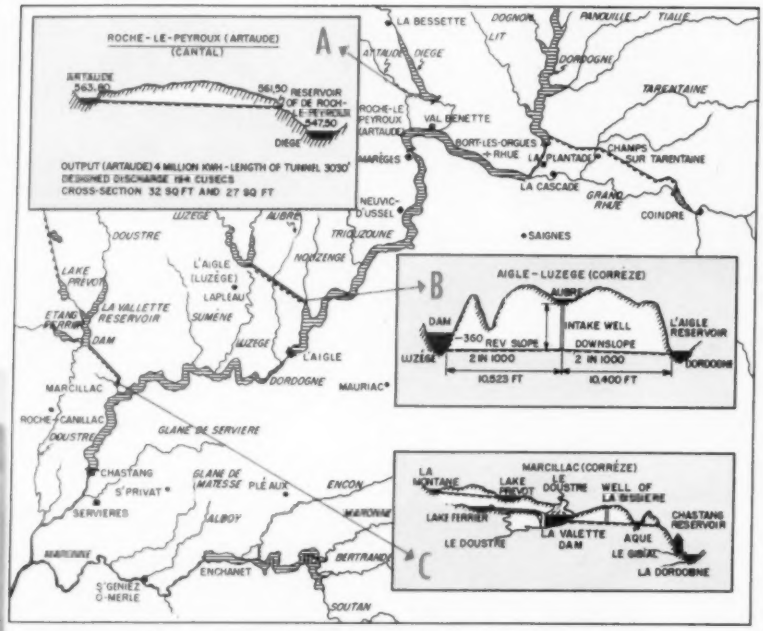


Fig. 8. Map showing principal features of Dordogne Valley development

The hydrology, types of development, and multiple-use problems of the Rhone and Rhine Rivers are very different from those of the mountainous regions we have just discussed. The French are justly famous for their pioneering of high-head power and for their rich contributions to its present status. The penstock developments of Georges Ferrand[2] and the audacious use of long tunnel diversions and pumped storage schemes stand as monuments to this leadership. On the other hand, though the comprehensive development of the Rhone was the subject of careful thought at the turn of the century,[3] and though a few low-head plants have always existed in France, French discussions of low-head developments contain many references to the lessons of American practice, particularly to the Tennessee Valley installations. But the French in utilizing American experience have not merely copied; their innovations and adaptations are such that the discussion of them deserves more space than is available here. They will thus form the subject of a paper to appear in an early issue.

North Africa

Hydroelectric development is being pursued vigorously in French North Africa as well as in France itself. Many of the installations are for dual use of irrigation and power with major emphasis on irrigation. In an effort to secure better firm power, large storage projects and, in particular, reregulating reservoir projects are under study and construction.

An interesting example is the development of the Oued Agrioun in Algeria. This river with a mean annual discharge of 146,000 acre-ft has a utilizable fall of 1531 ft in a short reach near the coast with a good reservoir site at its head. The fall is being developed in an upper power house, Iril Emda, and a lower power house.

Acknowledgments

Tables I and II and the three maps were reproduced from "Hydraulique et Electricite Francaises", a volume prepared under the direction of M. R. Giguet, Director of Equipment of Electricite de France and published in 1950 by La Houille Blanche, Grenoble, France. The author sincerely appreciates the permission so willingly granted by M. Giguet and by M. Francois Revol, Associate Director of La Houille Blanche to use these tables and maps.

He wishes to express his thanks also for the photographs furnished by M. Giguet and by l'Etablissements Bouchayer et Viallet and l'Etablissements Neyrpic, manufacturers of penstocks and turbines respectively of Grenoble.

[2] Whetstone. Improved Penstocks Reduce Costs for High-Head Hydro Power. POWER ENGINEERING. August 1951. Pages 64-69.
[3] Garcia. Les Forces Motrice du Haut-Rhone. Mem. Soc. Ing. Civil de France, 1901, pp. 576-621.

Chicago's Electric Theater Tells Story of Electricity

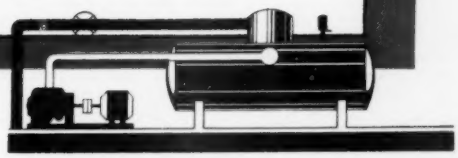
THE STORY of electricity, from Edison's first light to the largest lamp in the world, is the subject of a new exhibit at Chicago's Museum of Science and Industry. Sponsored jointly by Commonwealth Edison Co. and the Public Service Co. of Northern Illinois, the exhibit entitled The Electric Theater was opened to the public Friday, December 14. Formal presentation of the exhibit to the Museum was made at a luncheon preview by Charles Y. Freeman, chairman of the sponsoring companies, and was accepted by Major Lenox R. Lohr, museum president.

More than a year in construction and covering 6,800 sq ft of floor space, the Electric Theater, located in the west wing of the museum's entrance floor, comprises three sections. Entering the area, the museum visitor finds an ingeniously illuminated, modernistic theater foyer. Here and beyond the foyer in a lobby-like exhibition hall, visitor-operated exhibits demonstrate various consumer uses of electricity including street-lighting, the heat pump, and modern kitchen appliances.

The third section of the exhibit is a 200-seat theater where a 40-min stage show dramatizes the wonders of electricity. Opening with a brief motion picture showing how electricity is generated in a modern coal-burning steam generating plant, the show goes on to demonstrate how electricity is utilized in the form of various waves: electric, radio, infrared, visible light, ultraviolet, gamma, cosmic and X-ray.

The show closes with two modern-day light applications. The smallest electric lamp, no bigger than a grain of wheat, used in technical and medical fields, is compared with the largest lamp in the world — 50,000 watts, which produces enough light to illuminate a small community.

Filters Will De-Oil Your Boiler Feedwater



By GEORGE S. EMMERSON
College of Engineering, University of California

The facts concerning the contamination of boiler feedwater by lubricating oil were discussed in Mr. Emmerson's article in the February issue. Now, he discusses the use of filters—how they are used to remove oil from contaminated water. He describes various types and combinations of filters, their construction and discusses the characteristics of filter media. Finally he discusses their location in system, and how and when to service filter equipment

FILTERS VARY WIDELY IN DESIGN as well as in materials of which they are made, depending upon their application. Usually, filters are composed of beds of fibrous or granular material, or woven fabric on metal frames suspended in containers.

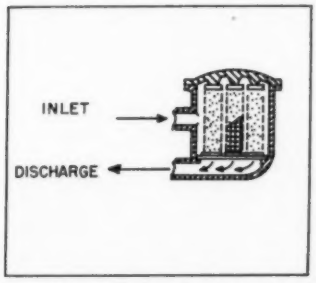


Fig. 1. Schematic diagram of a fabric cartridge filter

They are designed to operate under positive pressure, vacuum, or gravity. After selecting the filter media, the next important factor is the capacity rate or *throughput*. The larger the area of filtering surface, the less water treated per unit area in a given time, hence, the more thorough the filtration process. Space considerations, however, often restrict freedom of choice with respect to area.

Filtering media most favored for boiler feedwater are: coke, anthrafilt, sand, terry cloth, loofa sponge, cocoa fiber, hemp, hair, etc. Often a settling tank precedes the filter and serves to remove some of the oil by gravity separation, an arrangement obviating too frequent cleaning of the filter material.

As already explained (POWER ENGINEERING, February 1952, p 56) the globules of emulsified oil, as distinct from free oil found in steam engine condensate, are so minute that they will pass through ordinary filters of such materials as listed above. Special artifices and materials, therefore, are used to facilitate the elimination of the emulsion. These will be discussed later. Meanwhile let us consider the ordinary free oil filter.

Fabric Cartridge Filter

Perhaps the most common filter in use, especially in small plants or where space is seriously limited, is the cloth-cartridge filter comprising a number of perforated cylinders or cartridges wound in cloth. This type is shown in Fig. 1. The oily water passes into the filter chamber as indicated and to reach the discharge is obliged to pass through the cartridges. The lower end of each cartridge is fitted into a common base plate forming a partition between the filter chamber and the discharge. There are many versions of this principle, and valves are fitted so that the filter may be by-passed for cleaning. Usually, too, a pressure relief valve is required. The rate of flow is reduced by providing a filtering surface of 150 to 1000 times the area of the feed pipe. From tests using an oil of 600 W, fire tests 600 F, viscosity 183 at 212 F, it was found that the inlet velocity should not exceed 3½ ft per sec. Also more oil was absorbed at temperatures between 100 and 200 F than at temperatures outside of this range.

When the back pressure reaches values from 10 to 20 psi, the filter must be cleaned — the less viscous the oil, the shorter the intervals between cleanings. Cleaning is usually accomplished by replacing the fouled cartridges or by changing the terry cloth. In some designs, provision is made for skimming or running off the oil floating on the surface of the water in the containers. The contaminated terry cloths are usually cleaned by boiling in a caustic soda or soda ash solution.

Coke Filter

Ground coke has excellent absorbing properties. The coke generally used is the ordinary foundry brand broken up into fragments about the size of an egg with the dust washed out. Care should be taken that the coke used is acid-free. When contaminated with oil, the coke should be removed and replaced by a fresh charge. Some operators partially burn the contaminated coke to remove the oil, then return it to the filter, making up to the original quantity with fresh coke. This requires a kiln and is a

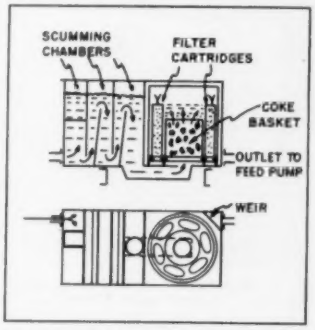


Fig. 2. Schematic diagram of a gravity and filter tank

disagreeable task. It is doubtful if rejuvenation of contaminated coke is worth this trouble.

Composite Filter Tank

In marine plants, it is common practice to use a combination of settling tank, terry cloth and/or coke filters. An example of a composite unit of this kind, shown in Fig. 2, comprises a tank with a number of baffles fitted at the feedwater inlet, and a meshed basket filled with coke surrounded by a number of terry-cloth filter cartridges. The baffles in the line of flow promote the separation of the larger oil globules before they reach the filters. The water is then led up through the coke basket and directed down through the filter cartridges to a common drain. It leaves the tank by way of a weir so placed as to insure that the entire filter is thoroughly submerged and that full advantage is taken of the large filtering surface. At the same time the weir serves to keep the grease-collecting surface high in the scumming chambers.

Sometimes the hot well is used as a filter tank and filled with sponges or coke. The sponges are cleaned after use in the same manner as terry cloth and used again.

Position of Filter Plant

In order to keep the size of the filter to a minimum, it is preferable to locate it in such a position in the feedwater system that it has to deal only with the oily condensate and not with make-up water. In order to prevent certain auxiliaries, the feedwater heater for example, from being contaminated by oil, it may be desirable to place the filter ahead of them. The most effective location of the filter then is on the condensate line from the condenser ahead of the hot well or feedwater heater. In this case, if an open-type heater is used, it is essential that the exhaust steam supplied to the heater be free from oil. If the filter is placed after the heater it is necessary to determine whether the filter should be installed on the suction or discharge side of the boiler feed pump. If the feed-pump discharge is high, the former is the more favored. However, it may be desirable to install a booster pump ahead of the filter to prevent flashing in the feed-pump suction. The lower the pressure to be carried by the filter, the less need there is for it to be heavily constructed.

Filtration of Emulsified Condensate

Emulsions may be eliminated in various ways, falling under one of two classes of procedure. One, to remove the emulsified oil directly in one operation. Two, first break or strip the emulsion, i.e., convert the emulsified oil into free oil, then remove the oil by settling or absorption. The methods range from the use of precoats, filter aids and porous bodies bearing a suitable electric charge, to chemical and electrolytic coagulation, involving both orthodox and novel types of filter.

De-Oiling with Precoats and Filter Aids

A finer degree of filtration can be achieved by the addition of a precoat which is the name given to a layer of finely grained material deposited on the filter surface before filtration begins. The precoat may be a material more readily wetted by water than by the liquid impurity, or it may have certain absorptive and adsorptive powers in addition to its fine porosity. Very often, however, the action of the pressure and stream impact causes the filtered impurities to form an impervious layer of minute particles on the surface of the precoat and so seriously impede the flow. To avoid this, it is frequently considered expedient to add the material, or some other chemically inert free-filtering substance, to the contaminated water, preferably of a specific gravity approximating that of the water.

In the removal of oil from condensate, diatomaceous earth is the only filter aid that has found any great favor. Several types of filters designed to use diatomaceous earth as a precoat or filter aid are known, all more or less operating on similar principles. First, the precoat of pure earth or earth mixed with a fibrous material, such as asbestos, to strengthen the bed against disintegration due to vibration or shock is deposited on the filter surfaces. Thereafter, the oily condensate is passed through the precoat layer and more diatomaceous earth is added, roughly in proportion to the concentration of oil present.

There are various grades of natural diatomaceous earth produced, varying in size of grain and purity. A special form of diatomaceous earth has been developed for the breaking and absorption of condensate emulsions. Usually it is a medium-grade earth treated with aluminum hydroxide to increase its absorptive effects. The recommended procedure for using this substance is the same as for most other filter aids. There is its additional property of coagulating the emulsified oil, and it is possible to utilize this effect by stirring the earth into the liquid and allowing it to settle. The manufacturers point out that this is not a good method as the finer particles of the earth settle only very slowly and therefore any

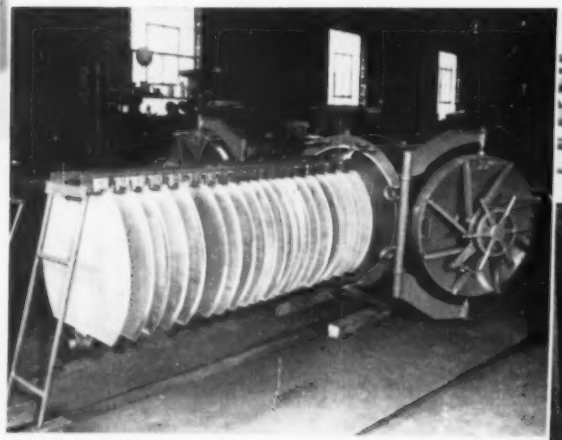


Fig. 3. Vertical leaf diatomaceous earth filter with the filter leaves withdrawn on cleaning rack (Courtesy of Davis "Clearflow" Filter Co.)

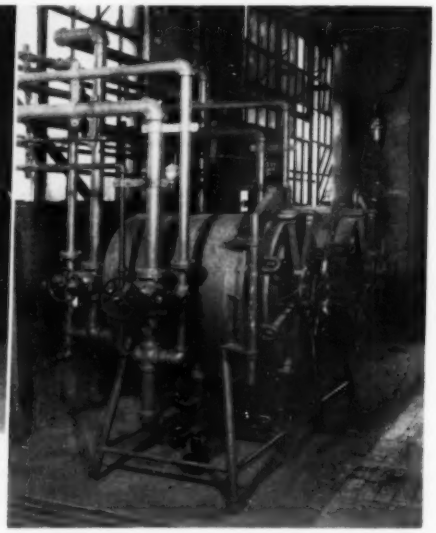
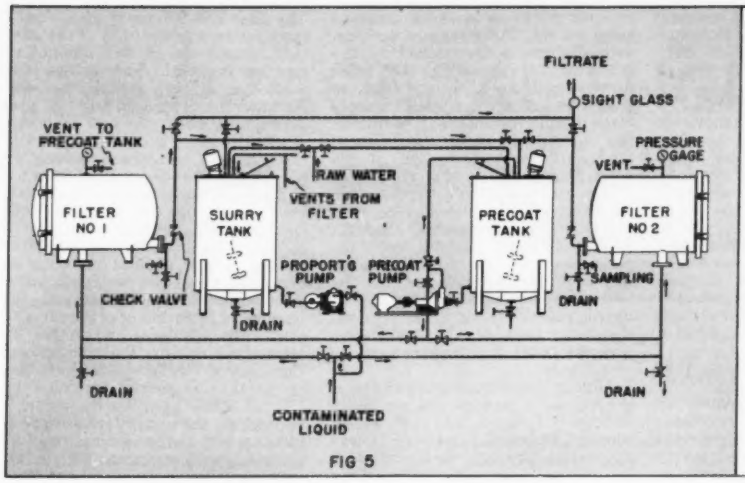


Fig. 4. Commercial installation of vertical leaf diatomaceous earth filters (Courtesy of Davis "Clearflow" Filter Co.)



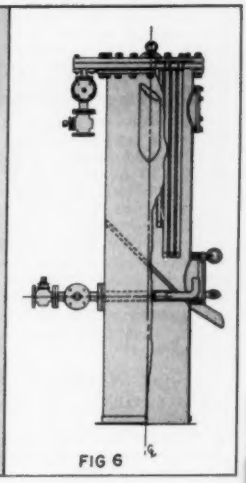


Fig. 5. Schematic piping diagram of a duplex filtration plant

Fig. 6. Section of a 500 gph water metafilter

of the liquid decanted from the surface would still contain silica which is detrimental to the boiler. It has not been found satisfactory to use this special filter aid with granular-bed filters as it forms a somewhat gummy cake, and no successful method has yet been devised for removing it. Backwashing has little effect as the cake simply ruptures at the weakest points. Successful results have been obtained using a pressure filter of suitable leaf or cartridge construction, in which case the earth can be easily peeled off manually.

Leaf-Type Filter with Diatomaceous Earth

A diatomaceous earth leaf-type filter now being widely used, especially with marine uniflow engines comprises the following salient parts: filter unit, mixing tank, precoat tank, and proportioning pump. The filter unit consists of a horizontal cylindrical tank containing a number of filter leaves suspended vertically. Each leaf consists of two fine mesh screens sandwiching a heavier mesh screen which acts as a spacer for draining the liquid to discharge eyes attached to the leaf frame. When several leaves are placed together, these eyes form a tubular channel which is connected to a discharge manifold. The oil-contaminated condensate enters the filter container through the top, bottom, or both, depending on the filter capacity, then passes through the filter screens to the discharge manifold.

The first step in the filter operation is to fill the system with water then place a mixture of diatomaceous earth and asbestos fiber, 1.6 and ½ oz respectively, per sq ft of filter area, in the mixing tank, where it is thoroughly mixed by means of an agitator. The mixture is then pumped directly to the filter by means of the precoat pump and continuously recirculated until all the material is deposited on the filter leaves. This operation takes from 8 to 10 min. Actual filtration may then proceed, and if the oil content is high, filter aid is added to the condensate by the proportioning pump in the proportion of 10 lb of filter aid per gal of oil to be removed. The filter aid then forms a cake on the leaves and gradually builds up a back pressure; the cycle is concluded when this pressure reaches a predetermined value which is usually between 20 and 30 lb psi.

The filter is easily cleaned. First the tank is drained and opened and the filter leaves are pulled out one or two at a time to a specially designed rack which has previously been placed in position to receive them. The filter cakes are removed by simply loosening the layer at the upper corner and peeling it off. The leaves are then returned and the filter closed, ready for another cycle of operation. The whole cleaning procedure can be completed in about an hour with negligible loss of water. Two filters are usually installed so as to operate as a duplex system.

The performance of this filter is extremely good, a filtrate containing less than 0.1 ppm of oil being procurable for cycles up to 120 hr, depending on the oil content of the condensate. Filters of this kind were chosen by the United States Maritime Commission in 1942 for installation in a group of aircraft carriers powered by uniflow engines operating under superheated steam. They have operated satisfactorily and filter cycles of 90 hr have been obtained without noticeable traces of oil in the boilers. Some hundreds have been installed in both land and marine plants.

A vertical-leaf unit is shown in Fig. 3, but horizontal-leaf designs are

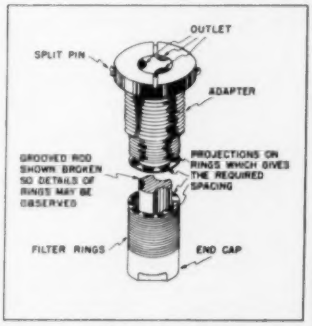


Fig. 7. Metafilter element

available. In these, the water descends vertically through horizontal screens and either passes off to peripheral headers as in the vertical type, or to a central drain. Sometimes, with this type instead of asbestos fiber, filter paper is placed over the screen to reinforce it.

Cartridge-Type Filter with Diatomaceous Earth

The cylindrical filter elements used in the vertical-cartridge type of filter designed to operate with a filter aid are either of meshed metal or some porous material. The earth is applied in the same manner as with the leaf-type filter. Porous ceramic cartridges have been used, and these have the merit of being rigid and shock-resistant as well as being easily backwashed with steam, hot water, or air, so obviating the need for opening the filter.

A cartridge of great interest is that of the Stellar filter. This is constructed from an accurately machined fluted cylindrical former with a fine thread cut the whole length across the flutes. This screw thread forms a groove for

the winding of the former with wire, so controlling the pitch and insuring the accurate spacing between consecutive turns necessary for consistent operation.

Edge Filters with Precoat

Essentially, edge filters comprise a number of laminated sheets or strips, usually held firmly together by a spring and mounted on a common shaft. A channel or groove runs along this shaft or alongside the shaft through the sheets, and the liquid to be filtered flows from the outer edges of these sheets inward towards the center where it is drained off through the channel provided. The laminated sheets are usually in the form of disks which, when held together, form a cartridge.

Metafilter

The metafilter was invented by Pickard in 1927 as an improvement on the edge filter. The filter elements are made with beveled edges tapering outwards from a central portion of uniform thickness in which drainage holes are cut. The clearance between each element is determined by the height of the ribs on the flat upper surface and may be as little as 0.0005 in. A bed of diatomaceous earth or other precoat may be used in the tapered grooves and because of the triangular cross-section of the bed, a given quantity of precoat forms a layer twice as deep as it would be, deposited on a plane surface. The fine particles are washed through, while the larger particles block the passages until a fine properly drained bed is formed in each groove. The lateral support of the bed provided by the sides of the grooves prevents disarrangement of the bed under pressure and the development of weak spots.

Disk or ring elements find the most general use nowadays and are shown in Figs. 6, 7, and 8. The rings are assembled, scalloped face upwards, on a fluted rod, and held firmly together by a screwed boss top and bottom. The filter bed is formed by inclosing the filter pack in the body of the filter then adding the correct amount of precoat material. The bed is deposited in an even graded layer and filtration may proceed until a predetermined back pressure is developed. The filter is then drained and the bed removed by backwashing. In the backwash process, the bed is expanded and washed off the filter pack to the sloping bottom, then out through the sludge door. The time to complete the backwash is, whatever the size of filter, about a quarter of an hour, and very little backwash water is required. With the precoat, the fineness of filtration approximates to that only otherwise obtainable by ultra-filtration in the laboratory. Commerical water metafilters are produced in capacities ranging from 500 to 12,000 gph. To the author's knowledge, the metafilter has not yet been applied to the elimination of oil from boiler feed-water, largely because few have known about it in this country — it is made in England.

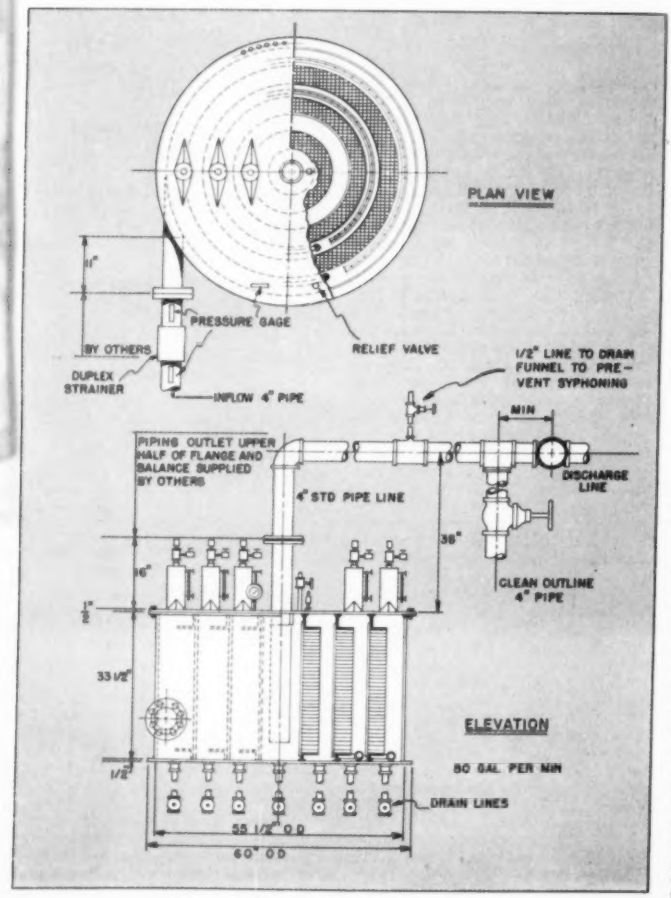


Fig. 8. Plan and elevation views of a Lawson de-oiler

Unaided Filters

There are few filters capable of eliminating emulsified oil from water by purely mechanical means, that is, without the assistance of one of the external agencies just discussed. These few belong to the group which do not absorb the oil but neutralize the emulsion, converting it to free oil which is easily removed. The advantages to be accrued from purely mechanical filtration, if it is effective, include the saving of storage space for filter aid or chemicals, as well as chemicals, as well as proportioning pumps and other auxiliaries — apart from cleaning facilities — connected with a filter aid or chemical supply. Unaided edge filters come into this category, and some which utilize mineral woods or activated carbon as filter media.

The Lawson Filter

The Lawson filter consists of three concentric filter elements of knitted steel wire arranged inside a cylindrical container as shown in Fig. 9. The oily water passes radially through the elements towards the center. The oil particles are separated out by the steel wire, coalesce, and rise to the top of the chamber. Oil reservoirs fitted with sight gages indicate the quantity of oil collected. Should a large slug of oil form on the separating elements, it may be detected by a decided increase in back pressure and the apparatus should then be cleaned. Cleaning is achieved by backwashing with steam and water and takes from 15 to 30 min. The manufacturers state that it has not been found necessary, in practice, to clean the filter in this way, and that it may be considered self-cleaning.

Editor's Note: This is the second of four articles dealing with the problem of oil contamination. The subject of chemical de-oiling will be considered in a third article to be published in a subsequent issue.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

PRACTICALITY PLUS GOOD LOOKS

Many years ago, when only a relatively few of even the top power utilities gave much attention to the matter, we published much editorial comment on the desirability of proper architectural treatment and good landscaping for power plants.

In the '20's, the utilities began to see the value of outstanding power plant appearance from the point of view of their general public relations problems, as well as an aid in good operation and in building operating staff morale. They began to have their power plants designed architecturally to look like power plants, not like something else. Industry, too, began to adopt many public relations policies that indicated it might be well to show off their power plants as well as their production facilities.

It is not necessary to remind engineers that power plants are no longer dirty, giving out great clouds of coal dust and smoke. But it is often wise to emphasize to the general public how clean the average power plant is.

On entering a power plant, especially a central station, the visitor is frequently taken first to the turbine room. And here, along with the beautifully-tiled walls, and usually a most artistic color scheme, he sees one or more great turbine generators in sleek, lonely majesty on an expanse of clean, beautiful floor.

That floor must look right all the time. And to look right, it must be built right. How this is done, step by step, you can read about in two of the following pages.

CONTENTS

How to Handle and Burn Stand-by Fuel Oil 72
By Paul F. Schmidt

To Produce Power Plant Floors Like This—Here's What They Do— 74

How To Caustic Wash a Turbine 76

Putting the Finger on the Sulphur Compounds in Your Flue Gas 78
By I. Klausner and P. S. Barnum

What Ailed the Centrifugal Pump? 80
By H. B. McDermid

Power Wires and Airplane Interference 81
By A. W. Gray

Practical Hints and Kinks 82
Plastic Pipe for Insulated Raceway on Pole Lines
Heating Cable Keeps Runways Free of Snow
Paper Funnel Useful in Emergencies
Insulation Tester
Improving the Tank Cutter
Chain Used as Washer in Emergency
Keep Diesel Fuel Clean
The Magic Formula for Rusty Threads
Another Voltage Problem with Welders

Questions and Answers 85
What's the Right Way to Take Fuel Oil Samples?
How Can He Stop Dirty Spray From Blow-off Tank Vent?
What is Best Heating System for a Church?
Reader Solved Coalhandling Problem
What Causes Point on Steam Engine Indicator Diagram?

A Section of POWER ENGINEERING Devoted to

PLANT OPERATION AND MAINTENANCE

Technical Publishing Company

110 South Dearborn Street, Chicago 3, Illinois

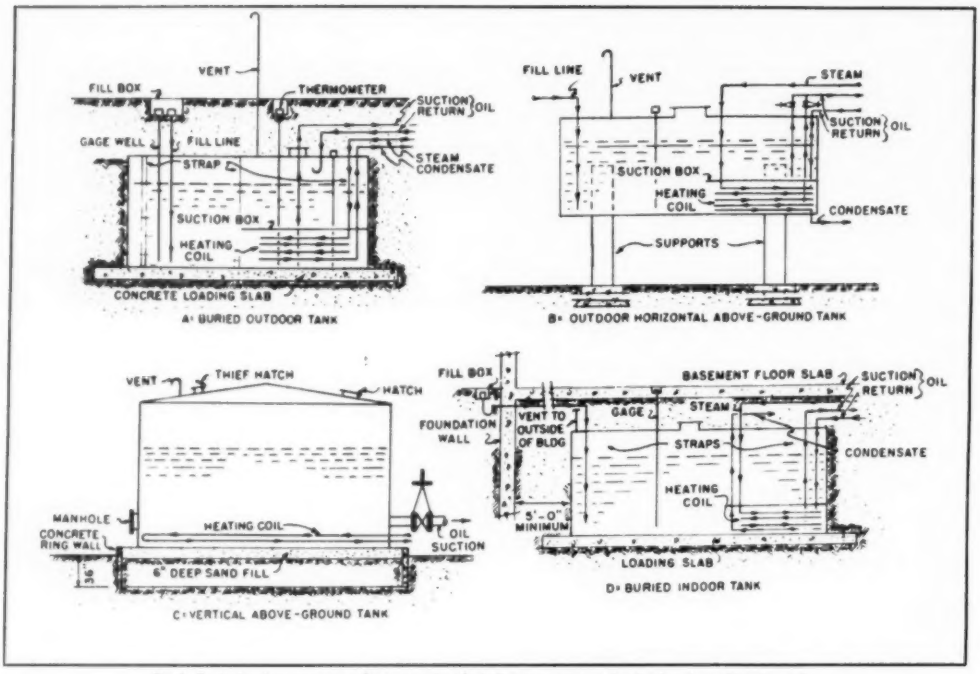


Fig. 1. Typical tank arrangements for power plant fuel oil storage systems showing locations of heating coils

How to Handle and Burn Stand-by Fuel Oil

By **PAUL F. SCHMIDT,** Allied Oil Co., Inc.

This article considers the troubles due to design of some oil-burning equipment which have a direct bearing on heavy stand-by fuel oil—Troubles occurring particularly with grades No. 5 and 6 stand-by fuel oil—Remedies and precautions to be taken when the oil is not used continuously, but only periodically as stand-by fuel

MANY INDUSTRIES TODAY are equipped to use more than one type of fuel. Which one to use is governed by either shortage or price. Of the three fuels, coal, gas, or oil, the utilization of fuel oil as a stand-by fuel presents a number of problems. Unfortunately, these problems appear at the time the oil is to be used, generally in cold weather.

Design Problems

Foolishly-designed oil-burning installations are one of the main sources of trouble. One of the most misunderstood factors in burning heavy fuel oils is what types of oils are specified by their grade numbers, meaning No. 5 and 6 oils. Many are of the opinion that No. 5 oils can be burned without preheating, and many installations are designed with that thought in mind. While part of this is due to the writers of fuel oil specifications, ignorance on the part of burner designers and installation contractors is also directly responsible.

The viscosity range of No. 5 oil is from 150 to 800 seconds, Saybolt Universal (S.S.U.). The 150-sec. viscosity oil is a fairly light oil, whereas the 800 viscosity oil is quite heavy. The light oil can be burned and atomized without any difficulty, but the high viscosity oils without preheating, produces poor atomization, resulting in inefficient combustion. Remember, with unheated oils, the pour point is an important factor, as well as viscosity.

To illustrate, the following comparisons will give a good idea of the changes, within the No. 5 oil viscosity range.

Viscosity at 100 F. S.S.U.	Approximate viscosity in underground tank, at temperature of 60 F.
150	425
200	750
300	1250
400	1750
500	2000
600	3000
700	4000
800	5000

To properly atomize and burn residual fuel oil, the viscosity at the burner should be from 150 to 200 seconds. If there is no preheater, you can easily see that the viscosities are too high to obtain good atomization. Remember, while your oil may have a certain viscosity at 100 F., it is the *viscosity* at your *operating temperature* that counts.

Anyone who burns a No. 6 oil should be able to burn all viscosities of No. 6, as the light end of the No. 6 viscosity range is heavy enough to definitely require heating coils and preheaters. Therefore, by applying just a little more heat, the heavier No. 6 oils can be utilized. In comparison, many installations using light No. 5 oils do not always have the necessary preheat for the heavier No. 5 oils.

As everybody is interested in saving money, the consumer or equipment installer specifies a No. 5 or 6 oil. When it comes time to use the oil, it is too viscous and thick to pump, and then the consumer finds he has no steam coils in his tank to heat the oil to make it fluid. It is always good policy to have them, whether or not they are used. Even when using a light distillate oil as No. 2, steam coils come in handy now and then.

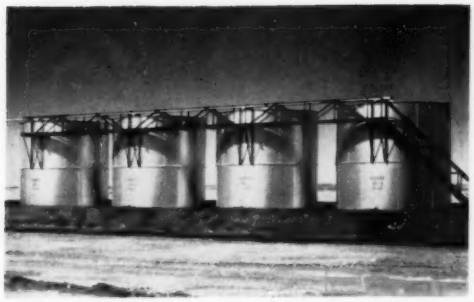


Fig. 2. Installation of above-ground fuel storage tanks. Earthen dikes prevent the spread of fires, roadway permits easy access by fire-fighting equipment

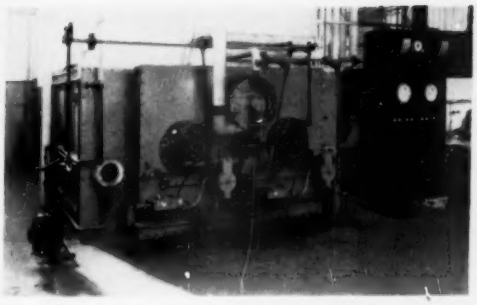


Fig. 3. Industrial oil burning installation. Well insulated oil piping saves heat and ensures good combustion at all times. Lower burners are for gaseous fuels

Where the stand-by oil is a light distillate, such as No. 2 oil, there should be no trouble as long as the pour point of the oil is low enough to permit a free-flowing oil at the operating temperature. This fact should be kept in mind if the oil is purchased during the warm time of the year.

Some Troubles with Fuel Oil

Where the most trouble occurs is when the equipment is designed to burn No. 5 and 6 oils. In many cases the oil is delivered hot, by truck, or heated in tank cars and pumped into the storage tanks. Normally where these oils are burned continuously and there are constant returns from burner to storage tank, enough heat is present to provide fluidity to the oil. As it is for stand-by use only in emergencies, due either to coal shortage or gas shut-off, the oil is allowed to remain undisturbed in the tank, sometimes for a considerable length of time, without any heat, thus congealing and thickening.

Many fuel oils are blended, but after standing for a time, separation and stratification occur. This may be due to poor blending, incomplete miscibility of the blending oils, or a wide spread in the gravity of the blending oils. Sometimes breakdown occurs even with well-blended oils. While the blended oil may have the proper viscosity when delivered, in time, your oil may have many different viscosities at various levels in the tank. Unfortunately, the heaviest oil will be on the bottom, where your suction line draws.

A recent example was a 500 viscosity blended oil delivered into a new underground, non-coiled tank. Thirteen months later when the gas was cut-off, it was necessary to use the oil, but the burner pump was unable to pull the material. Samples from various levels in the tank showed the following viscosities, starting from the top and going downward:

220 seconds at 100 F. Saybolt Universal
230 " " " " "
276 " " " " "
660 " " " " "
740 " " " " "
1040 " " " " "

A good idea of these viscosities at 60 F. which was the actual temperature in the tank, can be seen when compared with the previous mentioned viscosity changes or comparisons. The bottom sample had a pour point of 65 F., which did not help.

The tank had no steam coils, so it could not be thinned out and made pumpable. The tank was filled to the top, so no hot, light distillate could be pumped into the oil to thin it. The only remedy for this condition was to pump the oil by truck, which had a large size suction pump capable of pulling such viscous material. The pump-out required ten hours for 8000 gallons. The heavy oil was replaced with a No. 4 oil, which should cause no further trouble. Imagine what difficulties would have been encountered if the oil was unpumpable by the truck pump.

In this case, it was the equipment contractor that specified the type of oil to use, with no thought to conditions to be encountered later. Under immediate and constant use, this oil would have worked satisfactorily, as it would have remained fluid and stable enough to pump and burn.

A Problem with Cold Oil

Another example was a consumer using No. 6 oil as stand-by fuel and had no steam coils in his storage tank. One cold morning it was necessary for him to use this oil. His burner pump pulled some heavy viscous oil to the burner, but not enough for consistent operation. The flame would go on and off, as insufficient oil reached the burner. He phoned and complained about water, as he erroneously thought it was that which made his flame fluctuate. Fortunately, his tank was not full, so by the addition of a 1000 gallons of hot light oil, he was able to increase the flow of oil to the burner. Until he had enough hot returns back to the storage tank, he had a difficult time keeping his steam pressure up.

In those cases where the tanks are above ground, more care must be taken than where the tanks are beneath the surface. The temperature above the ground will be a great deal lower, close to the outside temperature, while the temperature in a buried tank will not be lower than 50 to 60 degrees in most localities.

Any long standing oil permits the sediment to settle to the bottom and accumulate, which otherwise would have remained suspended in the oil in such ratio as to cause no trouble. While all residual oils have some sediment present, this condition increases with some blended oils that are unstable, precipitating sludge and free carbon, which eventually settles to the tank bottom. Under normal, constant operation and use, this condition is not serious as the heavy material dropping out would not have time to accumulate and would thus be burned without any difficulty.

Remedies and Precautions To Be Taken with Oil in Storage

If you use heavy oil as stand-by and have no steam coils in the storage tank, do not let the oil remain in the tank too long without using it.

Store a lighter grade of oil than would normally be used, such as No. 2 or No. 4. This may mean greater consumption and a more costly oil, but better than no operation at all in an emergency, because the oil was too heavy.

A good blended 100 or 200 viscosity oil would be satisfactory in a non-coiled or non-heated tank, because if the oil did separate, the heavy material should not be too viscous to pump.

Have a preheater before the burner, so any heavy viscosities can be reduced.

Periodic agitation of the oil would be helpful, but not many operators have equipment to do so. This helps to reblend the oils, distribute the sediment, as well as break up the formation of wax crystals.

A thermal line heating system will help to heat the oil in the line from tank to burner, and then the preheater will bring the oil to the proper temperature for atomization.

To summarize, an understanding of the physical characteristics of the fuel oil at low temperature, and the type of equipment available to handle your particular oil will save a lot of trouble.

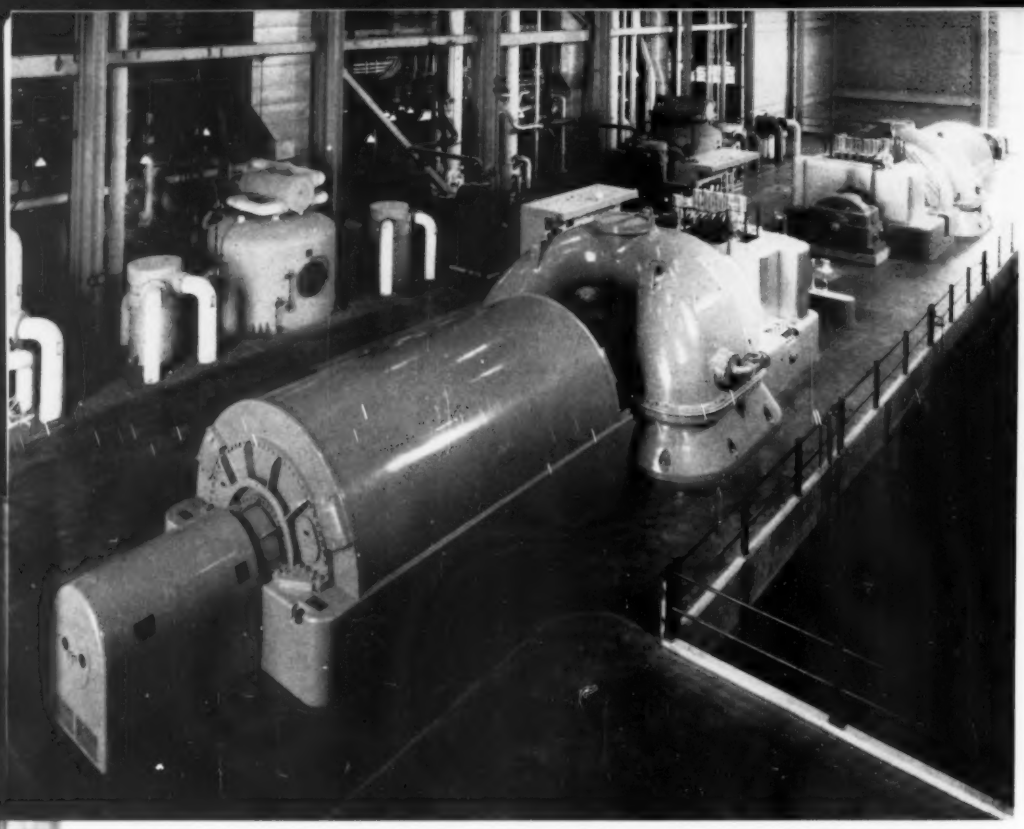


Fig. 1. View of the turbine room at the Potomac River Power Station of the Potomac Electric Power Company in Alexandria, Virginia. The floor is composed of high density red cement. The steps involved in its installation are described in the order of their occurrence in the following illustrations

To Produce Power Plant Floors Like This—

GOOD APPEARANCE as well as good performance are characteristics of the new Potomac River Power Station of the Potomac Electric Power Company in Alexandria, Virginia. Both inside and outside this station is a showplace. This is a typical characteristic of most utility power stations. One of the outstanding features is the floor in the turbine room, which is shown in Fig. 1.

This floor must meet several important specifications. It must be resistant to dusting, must have an exceptionally hard surface of uniform density and it must be well bonded to the underslab. Also, it must be able to withstand any chemical solutions used in water treatment that might seep out on the floor, plus the combined effect of temperature and vibration.

There are several other problems concerned with the laying of concrete floors in power plants. For example, there is the difficulty of distributing concrete evenly around the mass of small and large machinery installations, bolts, fittings, conduits, pipes and sleeves, which leave little uninterrupted floor space. The floor must be as near dustless as possible because of the large number of electric devices, relays, and the like, which would be damaged by dust. Ordinary concrete has too high a dust factor for power plant floor efficiency.

Laying a power plant floor presents another problem from the viewpoint of organization on the job. Often one unit of a plant may be in operation when another unit is being installed. Scores of technicians and workmen are on the job; machinery is being hooked-up and tested. While these operations are taking place, the floor must be laid without interfering with the other construction work. When ordinary floor is laid by a local or general contractor, confusion results many times because of their unfamiliarity with power plant working conditions and construction practices.

The last problem is that of maintaining the floor after it has been put down. The concrete must have a high density so as to resist oil drippings which is one of the things always present. Also, the floor must be able to withstand the hauling of heavy equipment, such as electric motors and valves, over the surface without marring or impairing its structural composition.

To produce a floor that will meet all the foregoing requirements, several important operations must be carried out. Figures 2 to 8 show these step-by-step as they are performed in laying a Kalman floor. This method is called the absorption process and here is how it is carried out. It produced the floor shown in Fig. 1.

The application of a good grout coat of clean cement is the first step in this process. This layer prepares

Fig. 2. These workmen are installing a grout of clean cement to the under-slab. This job must be well done in order that the topping layer of cement will bond properly, chance of scaling or cracking loose is eliminated

Fig. 3. Screeding the topping layer after it has been poured. Sufficient water content must be used to render good workability and uniform distribution of the aggregate

Fig. 4. After screeding, a layer of burlap is laid on top. Dry cement is put on the burlap to absorb excess moisture. Within a few minutes the concrete dries to a point where it is strong enough to support a man's weight

Fig. 5. When the concrete dries to the point it will support a man's weight the finishing operations of floating and compaction are begun. This is one of the operations which ensures a smooth, durable, hard surface

Fig. 6. Here an operator is doing the first of three finishing steps. Using a motor-driven machine he floats and compacts the concrete to make sure there are no cavities

Fig. 7. The second step of the finishing operation. The operator is using one of several machines to assure maximum density and uniform hardness and smoothness of the surface. Some hand troweling is also done

Here's What They Do—

the under-slab for the topping coat and assures complete adhesion of the topping to the undercoat. When this is done right you do not have to worry about the topping scaling or breaking loose when heavy equipment is dragged across or dropped on it.

How the Floor is Laid

When the grout coat is set, the topping coat is poured. This concrete contains $\frac{3}{8}$ in. crushed basalt rock. A floating screed is put down which helps level the topping to the specified elevation. Sufficient water content must be used in order to render good workability and uniform distribution of aggregate, especially in the corners and around the pipes, fittings and other obstructions.

The next step is the laying down of a blotter of burlap on which dry cement is spread to absorb excess moisture and immediately secure the correct low water-cement ratio. Within a few minutes the absorption process dries the concrete to a point where it is strong enough to support a man's weight. When this point is reached the concrete is in condition for finishing, and the burlap blotter is removed.

Finishing the Floor

Finishing is done in three steps. First, revolving mechanical floats do the initial compacting and float finishing. This step is done within ten to thirty minutes after the screeding operation, and is done before the critical stage in the setting of the cement is reached. Thus, any danger of the loss of surface quality through disturbances of the crystallizing reaction is removed.

The second step involves the use of several successive machine and hand troweling operations to further assure maximum density and uniform hardness and smoothness of the entire surface area.

Fig. 8. The final finishing operation is the hand troweling which these workmen are doing. This operation gives the floor an exceptionally close-textured, smooth dense surface which is practically dust-proof, and which makes the attractive surface shown in Fig. 1

The final hand troweling is the third step. This gives the floor an exceptionally close-textured, smooth, dense surface.

After this floor is installed, a coat of wax is usually applied. Many of the floors constructed as shown here are waxed only once a year. They require only a small amount of maintenance and refinishing to preserve the good qualities and appearance.

How to Caustic-Wash a Turbine

You may want to try caustic washing when, for one reason or another, cooling and contraction, water-washing or blasting with sand or fly ash won't remove your turbine deposits . . . If so, here are details of the general procedure used by nine utility companies in caustic washing . . . Also included are detailed procedure instructions given by one company for caustic-washing a topped 200-psig, 550-F condensing turbine; they have done it successfully.

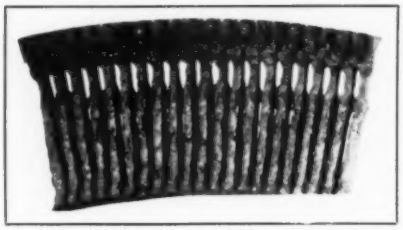


Fig. 1. This is what turns turbine men's hair gray — to see deposits like this in the turbine when it is opened for inspection. It means not only cleaning the turbine but going back into the boiler water to try to remove the cause of the deposit

CONTINUED CARRY-OVER from the boiler will result in an accumulation of deposits on the strainer, valves, and blading of steam turbines. Fouling of these parts is manifested by an increase in stage pressures at constant load, or by a reduction in load and efficiency if the turbine is operated at maximum capacity with constant inlet steam conditions. If the deposit is uniformly distributed throughout the blading with respect to percentage reduction in area, the stage pressures will remain about the same. However, steam capacity and load will reduce if the unit is operated at maximum valve opening.

If the deposits are distributed over certain sections of the turbine, which is the usual case, the stage pressures will increase more in those sections where deposits are present.

Blade deposits consist of soluble and insoluble material. When insoluble, the usual wet washing method will not remove these deposits. It then becomes necessary to either open the turbine and scrape off the deposit or wash it with a caustic solution, provided the materials in the turbine are not affected by the caustic. Turbine washing should not be resorted to as a regular procedure until every effort has been made to correct the boiler water condition that institutes the formation of this deposit. Where these persistent boiler water conditions exist, water conditioning by proper methods should be instituted.

Character of turbine deposits has been generally understood, ever since Straub and others began to study them in 1936. A good review of the cause of turbine deposits and the various methods of removing them was given in an article entitled Turbine Blade Deposits, Prevention and Removal, by Ralph E. Turner, *Power Plant Engineering*, December 1943.

The ideal method, and one that has been followed for many years, is to go back to the treatment of the original boiler make-up water and try to eliminate the substances in it carried over from the boiler in the steam to the turbine. Here they form either water soluble deposits or, in the case of certain silica scales, water insoluble deposits in the 400 to 550 F temperature section of the turbine.

Even a very small amount of scale-forming material in the original boiler water may be carried over into the turbine and eventually build up a deposit that must be cleaned.

Four methods of doing this, detailed by Turner, are: 1) cooling and contraction; 2) mechanical cleaning by blasting with special sand or fly ash; 3) water washing; 4) caustic washing.

Many turbine operators find one or more of the first three methods satisfactory. However, a number of turbine users not now using caustic washing are interested in learning about it because they think it may help them in reducing outage time for cleaning.

Detecting Deposits

Three effects of accumulation well known to turbine operators, are measurable while the turbine is in operation. These are: 1) increase in shell pressures; 2) reduction in efficiency; and 3) reduction in capacity. Changes in these three characteristics can be detected by comparing the values obtained when it is known or suspected the turbine has accumulated deposits against corresponding values for the turbine when it is known to be clean. Careful measurements of flows, shell pressures, steam conditions and load should be made as soon after installation as the turbine has attained its best operating condition.

This set of readings can be used for comparison during the life of the turbine, as in Fig. 2 by Turner. When variations occur, the causes should be determined and corrections made. Gradual change in shell pressure is probably the most significant indication of an accumulation of deposit.

Many successful operators at the time Turner wrote favored examination of the turbine after the first year of operation. Then they lengthened the operation interval to approximately 10,000 hr between inspections. Such operators see the wisdom of developing a systematic and thorough procedure for checking and recording of wear, erosion and gradual deterioration. From the data gathered at these times of inspection, they can determine the desirable frequency of deposit removal periods. During and since the war, the periods between inspections have been greatly lengthened by many operators.

What Various Plants Do Today

To find out something about present-day practice, the Power Station Subcommittee of the Prime Movers Committee, Edison Electric Institute, recently sent a questionnaire to 26 utility companies to determine what experience they had had with caustic-washing to remove deposits.

Their replies are tabulated, summarized and commented on in Power Station Chemistry, 1951, Publication No. 51-9 of the committee.

Of the 26 utilities reporting, 17 reported no experience with caustic washing. Either they had NO deposits or, if they had, were able to remove them satisfactorily by water washing or mechanical methods or combinations of both. Several of these

Editor's Note:—It should be noted that the generally-recommended practice, when insoluble deposits are found in turbines, is to go back to the boiler water and try to remove the cause of the trouble by proper water treatment. Turbine manufacturers recommend this, of course. One turbine manufacturer says caustic washing is like gargling with carbolic acid. Nevertheless, caustic washing is practiced by 9 out of 26 utility companies, approximately ⅓ of those questioned on this point. As with many other procedures used in power engineering, caustic washing must be done expertly and carefully, when it is done at all, so that the cure will not be worse than the disease. Hence we are publishing the accompanying data from an authoritative source, to show what is being done.

Procedure for Caustic Washing Topped 200-Psig, 550-F Condensing Turbines

Procedure Employed by One Utility Company

This procedure is to apply to the caustic washing of turbines at station, and supersedes any previous caustic-washing procedures.

Preparation

All manipulation of the turbines is to be done by the Production Department. During the washing, all condensate from the condensers must be overboarded. All primary valves must be wide open during the washing and secondary valves closed, which may involve disconnecting the secondary valve linkage. During the caustic injection, the condenser vacuum must be high enough to give at least 1-in. mercury vacuum on the leak-off connection to prevent loss of caustic solution. During the soaking period, the vacuum must be broken.

A 12-per-cent-by-weight caustic solution is to be admitted by gear pumps through an injection nozzle, made of a piece of flattened pipe, into the primary valve chamber at a rate of 2 gal per min.

Procedure

1. Turbine is to be rolled with superheated, 200-psi steam for at least one-half hour at 200 to 300 rpm to ensure its being hot.

2. With the turbines rotating at 200 to 300 rpm and head drains closed, the 12-per-cent-by-weight caustic solution is injected into the primary valve chamber for 30 min at a rate of 2 gal per min. This is called a ***washing period.*** Before injecting caustic, atomizing steam must be turned on to about 15-lb pressure and not turned off until after caustic injection is completed.

The effectiveness of the caustic-wash is dependent upon maintaining high turbine temperatures during the caustic injection, which is facilitated by operating under the poorest possible condenser vacuum.

3. Shut off caustic solution, inject water through caustic-injection nozzle for sufficient time to clear nozzle, shut off steam, and allow machine to stand at rest. This is called a ***soaking period.*** The total elapsed time from shutting off steam to Step 4 is to be 30 min. Head drains are to be opened during soak, closed during injections.

4. Start turbine, adjust speed to 200 to 300 rpm, and inject caustic as in Step 2 for 15 min.

5. Shut off caustic and soak as in Step 3 for 15 min.

6. Repeat Steps 4 and 5 a total of six times.

7. Start turbine with head end drains open. Adjust speed to 200 to 300 rpm and introduce water into the steam. Adjust water flow so that the steam temperature is reduced to about 210 F, at a rate not exceeding 75 F per hr. After saturation temperature is reached, drains are to be closed. Continue admission of low temperature steam until sodium hydroxide and silica content of condenser condensate, for two consecutive half-hour periods after saturation temperature is reached, are both below 50 ppm. This is called a ***rinsing period.***

8. Repeat Steps 1, 2 and 3.

9. Repeat Steps 4, and 5 a total of three times.

10. Repeat Step 7 and, after saturation temperature is reached and the sodium hydroxide concentration has dropped to about 200 ppm, increase speed to 400 to 500 rpm and reduce again several times until no increase in sodium hydroxide is noted. Continue the rinse until the concentrations of both sodium hydroxide and of silica for two consecutive half-hour readings do not exceed 10 ppm each. The rinse will be accelerated by using the maximum amount of water that can safely be put through the machine after saturation temperature is reached. The controlling factor usually is the flooding of the steam line, which must be avoided.

11. Shut off steam and water.

12. Turbine is then to be brought gradually up to approximately 80 per cent of full load over an eight-hour period in the normal manner. Steam temperatures, stage pressures, and vibration readings should be observed and recorded at frequent intervals during this period.

13. If, at the completion of Step 12, all conditions are satisfactory, the turbine is ready for service.

companies, however, expressed interest in caustic washing as a means of shortening service outage time.

The quantity of caustic employed for caustic washing ranges from 100 to 500 lb. There appears to be no relationship between the amount of caustic used and the type or rated capacity of the unit cleaned. The caustic concentrations range from ½ to 5 gpm.

The caustic-washing procedure involves two or more cycles consisting of caustic-injection and of *soak* periods. The caustic-injection periods range from 8 to 50 min and the *soak* periods from 15 to 60 min. The water-washing, following caustic treatment, is accomplished principally by condensate or softened water, or both. This is continued until the contents of the caustic and of the silica are only a few parts per million above the amounts originally contained in the wash water. The time required for the water-wash ranges from 3 to 20 hr. The effectiveness of cleaning by caustic washing has been found, in most cases, to be between 75 and 100 per cent, as indicated by restoration either of capacity or of pressure differentials. In three cases reported, the effectiveness was lower, but was at least 50 per cent. A closer study of these three instances indicates the turbine temperatures at the start of the wash and the caustic steam temperature were about 300 F and lower. The minimum temperature for effective cleaning appears to be about 350 to 400 F.

Basically, all the caustic-washing procedures are similar. They differ only in such details as casing temperature, temperature of the injected caustic-steam mixture, quantity and concentration of caustic used, and the duration of the injection and soak periods. Variations are not large enough to prevent obtaining reasonably successful results. It appears probable the washing technique can be improved by a critical study of current practices.

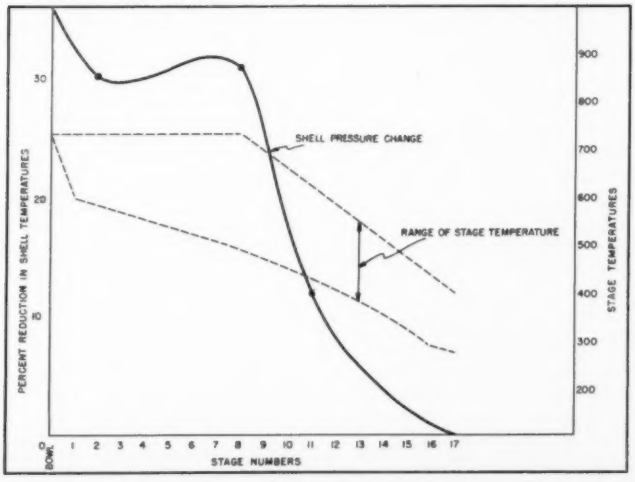


Fig. 2. One method of detecting presence of deposits is by comparing shell pressures of turbine in operation with pressures immediately following a cleaning. This curve indicates reduction in shell pressures due to removal of blade deposit from a high pressure turbine taking 665-psia 730-F throttle steam

Precautions to be Observed in Caustic Washing

1. In any operation involving either heating or cooling the unit, before, during or after the caustic washing, the rates of cooling or heating should be maintained within the manufacturer's specifications.

2. The maintenance of high temperatures of turbine parts on which deposits exist during caustic injection and during the soaking periods is essential to effective cleaning. These temperatures, which should be at least 350 F, may be obtained from stored heat in the turbine casing or, if necessary, by admission of hot steam during the soaking period. No

conclusion has yet been reached regarding the permissible upper temperature limit.

3. It should be recognized that, upon heating an atomized caustic solution to 350 F, the solution will be concentrated to 60 per cent or greater. Also, solutions of these concentrations freeze at about 125 F. Therefore, it is imperative that highly concentrated caustic solutions be diluted or removed from the turbine and associated bleed, drain, and instrument lines before temperatures are permitted to be reduced sufficiently to permit freezing of the caustic.

4. The point of admission of the caustic should be selected to insure even distribution over the surfaces to be cleaned. This is generally accomplished by injecting the caustic into the primary control-valve chamber. However, precautions should be taken to prevent the caustic from entering close clearance spaces from which it cannot be removed by rinsing. These precautions apply particularly to control valves with stems projecting downward.

5. All valves downstream from the points of caustic injection should be maintained either fully open or closed until the rinse period has been started. Operation of these valves may permit caustic to work into packing.

6. Casing drains should be fully closed during caustic injection to prevent loss of caustic through the drains. Loss of caustic in this way may have the result that either insufficient caustic or none at all reaches the surfaces to be cleaned.

7. Casing and bleed-line drains, and instrument connections, should be fully opened at intervals during the rinse periods to remove any accumulated caustic in the lines. Failure to remove this caustic may result in later clogging of lines.

Putting the Finger on the Sulfur Compounds in Your Flue Gas

By I. KLAUSNER and P. S. BARNUM
The Narragansett Electric Company

Sulfur's sins in boiler flue gas are many . . . They are especially bad in air heaters and economizers . . . But before you can eliminate them, you must first find out how much sulfur you've got to contend with . . . SO_2, sulfur dioxide, is not directly responsible; SO_3 is really the culprit . . . Here's a brief review of how the sulfur compounds form in your flue gas in relation to the dewpoint . . . And a relatively simple method of finding out how much SO_2, SO_3 and sulfates . . . This method was applied to the flue gas from an oil-fired boiler and the results tabulated . . . Over 90% of sulfur was found as SO_2 and only 2% as SO_3 . . . Chemical and power plant articles listed

WHEN FUEL is burned, the sulfur contained in it combines with oxygen, forming sulfur dioxide, SO_2. This SO_2, combining with oxygen, O_2, may oxidize to sulfur trioxide, SO_3.

Effect of SO_2 on Boiler Corrosion

If the flue gas temperature is below the dewpoint, water vapor will condense and may absorb or dissolve sulfur dioxide. Then corrosion due to direct action of sulfurous acid, H_2SO_3, will take place. Sulfur dioxide has little effect on the dewpoint; that depends upon the water vapor concentration in the gas. In the absence of sulfur trioxide, all the metal temperatures of the boiler are normally above the dewpoint. Thus, sulfur dioxide is unlikely to be directly responsible for corrosion in economizers and air-preheaters.

However, in the presence of a liquid phase, such as a light condensation of sulfuric acid, sulfurous acid will dissolve and oxidize to sulfuric acid and corrosion due to sulfuric acid will then take place. Sulfuric acid might be generated continuously in certain circumstances by that method. By increasing the flue gas temperature and hence diminishing the solubility of sulfur dioxide, the rate of oxidation to sulfuric acid may be diminished and corrosion may be decreased.

Effect of SO_3 on Boiler Corrosion

Besides sulfur dioxide, SO_2, the flue gases leaving the boiler may contain sulfur trioxide, SO_3, which unites with water vapor to give sulfuric acid, H_2SO_4. The amount of sulfur trioxide is usually very small in comparison to the amount of sulfur dioxide, but its influence on boiler corrosion is very great.

The formation of sulfur trioxide is due to the oxidation of sulfur dioxide:

$$SO_2 + \tfrac{1}{2}O_2 \rightleftarrows SO_3$$

The reaction is reversible. If the reaction takes place without a catalyst, the yield of the trioxide is extremely small. The rate of the reaction is greatly increased when the mixture of sulfur dioxide and air is led over a catalytic agent: metal, oxides, sulfates, refractory. The appropriate temperatures for the catalytic oxidation are between 500 and 1200 F, with the best yield at about 800 F. Oxidation cannot take place above a temperature of about 2500 F.

Iron, especially in the form of oxide and sulfate, is an effective catalyst in the oxidation of sulfur dioxide to sulfur trioxide.

Oxides of vanadium are excellent catalysts. In coals, only traces of vanadium can be found. In fuel oils, the vanadium content is highly variable and the ashes may contain from a trace to a maximum of 75 per cent of V_2O_5. Venezuelan and Middle East oils are considerably higher in vanadium content than domestic oils. Oils of different origins are often blended to meet fuel oil specifications.

The presence of sulfur trioxide is of great importance to the dewpoint of the flue gases. Traces of sulfur trioxide raise the dewpoint considerably. Minute addition of sulfur

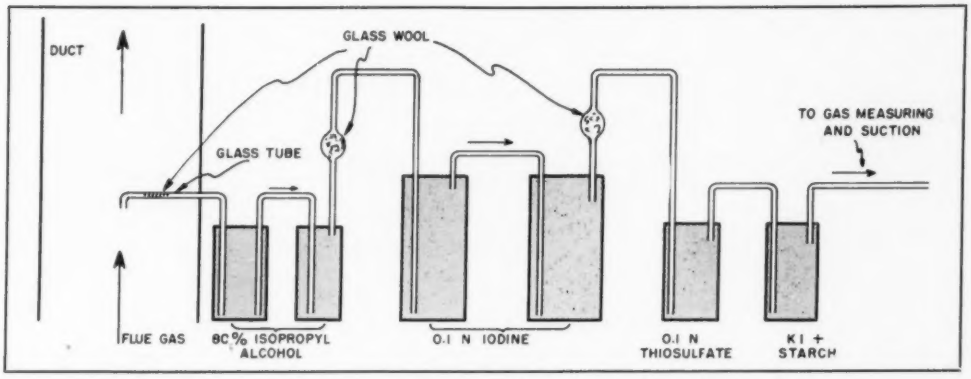


Diagram of test apparatus for collecting and testing samples of flue gas for determination of SO_2, SO_3 and sulfates

trioxide can elevate the dewpoint of the flue gases to 300 F and even higher. If all metal temperatures are not above the dewpoint, sulfuric acid will condense and the strength of the condensed acid will depend mainly upon the concentration of sulfur trioxide and water vapor in the gases. Intensive direct corrosion will result.

The condensed sulfuric acid would attack the metal surfaces. It would also assist in the oxidation of sulfurous acid, H_2SO_3, to sulfuric acid, H_2SO_4. It would react with the deposited fly ash to produce substances such as iron sulfate and alkali bisulfates and sulfates. These substances are hygroscopic and will adhere to the wetted metal surfaces, block the gas passages and increase corrosion. In addition, sulfuric acid will react with alkali salts volatilized from the fuel during combustion and form low-melting sulfates.

Experiments by Whittingham (15) have shown that the formation of sulfur trioxide, due to the reaction $SO_2 + \frac{1}{2}O_2 \rightarrow SO_3$, may be inhibited when a certain highly reactive and suitable dispersed material is present. Such a inhibitor is silicon monoxide released at high temperatures (above 1200 F) by the action of carbon and silicates contained in the ash. It reacts with oxygen of water vapor in the combustion gases to give silica in an extreme state of sub-division. The high dewpoint due to the presence of sulfur trioxide is reduced. Any inter-reaction between films of silica and sulfuric acid is of secondary importance. The principal role of the silica smoke is to bring about a reduction in the SO_3 content of the gases.

Relation Between SO_3 Content of Flue Gas and Dewpoint

The dewpoint gives the temperature at which the first droplet of liquid is formed when the gases are cooled.

In the absence of sulfuric acid, the dewpoint can be considered as due only to the condensation of water vapor. The dewpoint is then the temperature at which the vapor pressure of water equals the partial pressure of water vapor in the gases.

When sulfuric acid is present, the gases may be considered, so far as condensable gases are concerned, as a two component system: $H_2O - H_2SO_4$. The dewpoint will depend therefore on the partial pressures of those two components. The sulfuric acid content in the flue gases could then be calculated from the dewpoint, provided the partial vapor pressures of water and sulfuric acid are known at various temperatures and at various concentration of sulfuric acid in solution.

Effect of Alkali Sulfate on Boiler Corrosion

Metallic sulfates are usually found in boiler flue gas. Sodium sulfate is highly corrosive in the molten as well as in the vapor states. It attacks steel at temperatures above 1200 F. The melting point of sodium sulfate is comparatively low: 1623 F. It lowers the melting temperature of the ashes, and fuses with the refractory brick, forming slag and causing erosion of furnace walls.

Briefly, the action of sodium sulfate is very similar to that of vanadium pentoxide, but the latter has a still lower melting point, 1274 F, and is a powerful catalyst in the oxidation of SO_2 to SO_3.

Simultaneous Determination of SO_2, SO_3, and Sulfates in Flue Gas

The procedure is based essentially on the method described by Flint (5).

Table I. Amounts of sulfur compounds found in flue gas of typical oil-fired boiler as described in text

SULFUR IN FLUE GAS— Gas reduced to OC-760 mm Hg		
SO_2	1.5 to 2.9	Grams per cubic meter
SO_3	0.045 to 0.065	Grams per cubic meter
Na_2SO_4	0.033 to 0.080	Grams per cubic meter
$FeSO_4$	Trace to 0.035	Grams per cubic meter

The necessary arrangement for sampling and testing the flue gas is shown in the accompanying diagram.

The gas passes through the glass tube containing glass wool and placed inside the preheater duct. This retains the sulfates, and no condensation of H_2SO_4 takes place. It then passes through the isopropyl alcohol solution to remove the sulfur trioxide, and the iodine solution to remove the sulfur dioxide. A thiosulfate solution follows to retain any escaped iodine. The gas passes a solution of potassium iodide with starch added, to make certain that all sulfur dioxide is absorbed.

When sampling is completed, the glass tube is removed and the portion of the tube near the cooler outlet, where condensation of H_2SO_4 may take place, is cut off. The tube containing the glass wool is washed with H_2O; the wash-water and the glass wool are collected in a beaker, boiled and filtered. Sulfates in this solution are determined gravimetrically.

The other portion of the glass tube is washed with H_2O and the washings added to the isopropyl alcohol solution.

SO_2 retained in the isopropyl alcohol solution is removed by passing oxygen-free nitrogen and absorbing the gases in 0.1 N iodine solution. The SO_2 absorbed by the combined iodine solutions is determined by titration.

Results of Tests

Tests were made on the flue gas entering the preheater of a Babcock and Wilcox boiler, cross-drum type, generating 200,000 lbs of steam per hour at 700 F and equipped with mechanical oil burners. The gas

Table II. Distribution of sulfur in flue gas of Table I, given in percentage; sulfur content of fuel oil taken as 100%

SULFUR DISTRIBUTION IN FLUE GAS	
Sulfur as SO_2	92%
Sulfur as SO_3	2%
Sulfur as Na_2SO_4	1%
Sulfur as $FeSO_4$	Trace to 1%

temperature was about 560 F. The fuel used was heavy Bunker C oil. Ash content of the oil varied from 0.055 to 0.85 per cent and the sulfur content from 1 to 2 per cent. The oil was practically vanadium free. Tables I and II summarize the test results.

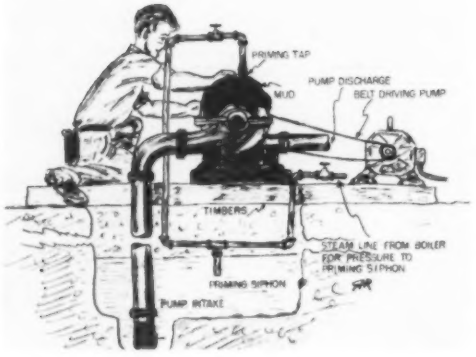
The authors are indebted to the Narragansett Electric Company and particularly to E. F. Walsh for permission to publish this investigation.

References

1. ASME, Annual Meeting; Nov. 26–Dec. 1. *Combustion*, 1950.
2. Corbett, P. F.; *J.S.C.I.* Vol. 67, P. 222, 1948. A Phototurbidimetric Method for the Estimation of SO_3 in the Presence of SO_2.
3. Dooley, A. and Whittingham, G.; *Trans. Faraday Soc.* P. 354, 1946. The Oxidation of Sulfur Dioxide in Gas Fumes.
4. Evans, C. T.; *ASTM* No. 108, 1950. Oil Ash Corrosion of Materials at Elevated Temperatures.
5. Flint, D.; *J.S.C.I.* Vol. 67, P. 2, 1948. A method for the Determination of Small Concentrations of SO_3 in the Presence of Larger Concentrations of SO_2.
6. Harlow, W. F.; P. 359; *Inst. M. E.*, Vol. 160, 1949. Causes of Flue Gas Deposits and Corrosion in Modern Boiler Plants.
7. Johnstone, H. F.; University of Illinois, Circ. No. 20, 1929. An Electrical Method for the Determination of the Dewpoint of Flue Gases.
8. Johnstone, H. F.; University of Illinois, Circ. No. 228, 1931. The Corrosion of Power Plant Equipment by Flue Gases.
9. Liander, H.; *Combustion*, 1950. Damage to Superheaters and Air Preheaters with Oil Firing.
10. Rylands, J. R. and Jenkinson, J. R.; *Inst. M. E.*, Vol. 158, P. 405, 1948. The Corrosion of Heating Surfaces in Boiler Plants; Further Studies in Deposit Formation.
11. Taylor, A. A.; *Ind. Fuel*, Vol. 16, P. 25, 1942. Relation between Dewpoint and the Concentration of Sulfuric Acid in Flue Gases.
12. Tolley, G.; *J.S.C.I.* Vol. 67, P. 369 and 401, 1948. The catalytic oxidation of Sulfur Dioxide on Metal Surfaces.
13. Yeaw, J. S. and Schnidman, L. *Power Plant Engineering*, Jan. and Feb., 1943. Dewpoint of Flue Gases of Fuels Containing Sulfur.
14. Walsh, E. F.; Meeting, May 2–4, *ASME*, 1948. Some Aspects as to the Cause and Prevention of Slag Deposits on the Heating Surfaces of Modern High-Pressure Boilers.
15. Whittingham, G.; *J.S.C.I.*, Vol. 67, P. 411, 1948. The Influence of Silica Smoke on the Dewpoint of Combustion Gases Containing Sulfur Oxides.
16. Edison Electric Institute, Prime Movers Committee; Publication No. 50–13, February 1951. Deposits on Gas Side of Steam Generating Units.

What Ailed the Centrifugal Pump?

By H. B. McDERMID



Centrifugal pump covered with mud to stop leak. Also shown is the priming siphon hook-up

A LARGE steel plant making shell steel during the war was building a much needed addition. This plant was located in a valley with hills on all sides. One large excavation filled with water, either from springs or ground water seepage. The contractor's master mechanic's problem was to get the hole dry enough for form carpenters to work, as soon as possible. There were no pumps of adequate capacity on the job and with wartime scarcities it began to look as if none were to be found. However, one was found at a secondhand dealer's.

The pump was set up on a temporary platform of heavy timbers laid across one edge of the hole. The belt-driven centrifugal pump had an 8-in. suction pipe and a 6-in. discharge. A small vertical boiler was set up to provide pressure to a priming siphon. When the equipment was all set up, the siphon was started and the pump was primed. When the pump went into action, it threw a full-sized stream for only a few seconds and then stopped pumping.

The crew suspected a suction-pipe leak that was not great enough to overcome the siphon capacity when the pump was shut down, but which would open up when the pump began revolving. This might be enough to kill the suction. Tightening of pipe joints and careful visual inspection of the pump itself failed to show the trouble. Repeated attempts to run the pump did no good.

An ingenious pipe fitter, noting the deep gooey clay mud that lay everywhere underfoot, grabbed handfuls and began plastering the outside of the pump casing with it. In a short time he had the entire casing looking like a big ball of mud. Now he started the pump again and this time the discharge pipe ran a full stream and stayed that way.

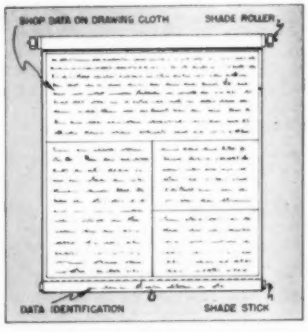
The hole was soon pumped out, a sump was dug and the suction pipe was extended well below the bottom of the main pit. This kept the bottom of the hole relatively dry; the forms were placed and the concrete was poured without further trouble.

When the emergency was over and the crew had time, they dismantled the pipe from the pump, and flanging off the openings, put an hydraulic pressure test on the pump casing. This quickly showed what the trouble was. At some time, the casing full of water had apparently been allowed to freeze up. The resultant expansion had caused a small hairline crack to open in the suction side of the casing. This crack was too small to be seen easily, but was big enough to destroy the necessary vacuum in the suction line when the pump went up to operating speed. Once the location and extent of the hairline crack were established, a welding torch soon repaired it permanently.

This experience shows how unorthodox but direct methods sometimes get a crew out of an emergency after trying for hours to solve their problem by usual ways.

SHOP CHARTS

DATA referred to from time to time in the shop can be conveniently available, yet take up a minimum of space, if they are written on drawing cloth with drawing ink and the cloth mounted on discarded window shade rollers, as shown. The rollers can be full width or may be cut to suitable lengths.



Power Wires and Airplane Interference

To what extent is a power company responsible in cases where airplanes crash into transmission towers or the power lines? In this short discussion of the subject, Mr. Gray cites four court decisions in all of which the rights of the power companies to the use of their right-of-way was upheld.

By ALBERT WOODRUF GRAY

THE GROWTH in aviation has emphasized that century old law that the ownership of land extends to the edge of the universe. A private airplane attempting to land at the Patrick Airfield near Chico, California, collided with the power wires of the Pacific Gas & Electric Co. strung the legal distance above the ground and running parallel to the border of the airfield.

In his suit against the power company the airplane owner insisted that the company had been guilty of negligence in failing to display danger signs for these wires that interfered with the air lane above the land.

In its decision a few months ago the California court held that the interference of these wires with air traffic which had been a factor in this accident, imposed no obligation on the power company. The law governing the rights of land owners in the air above the land had been settled by the United States Supreme Court.

"We have said that the air space is a public highway," said that court. "Yet it is obvious that if the land owner is to have full enjoyment of the land he must have exclusive control of the immediate reaches of the enveloping atmosphere. Otherwise buildings could not be erected, trees could not be planted and even fences could not be run. The land owner owns at least as much of the space above the ground as he can occupy or use in connection with the land."

This statement of the law, said the California court in conclusion, certainly is a justification of the power company's construction and maintenance of these wires and poles.

A controversy over the rights of the land owner in the use or enjoyment of the space above his land was the subject of a lawsuit decided by the Supreme Court several years ago on an opinion written by Justice Holmes.

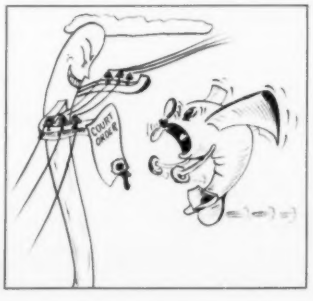
The guns of a government coastal battery on Gerrish Island off Portsmouth Harbor had fired over nearby land on which was a summer hotel. "If the government had installed this battery with the purpose and effect of subordinating this land to the right and privilege to fire projectiles directly across it with the result of depriving the owner of its profitable use, the imposition of such a servitude would constitute an appropriation of the property," said Justice Holmes in holding that the government was liable in damages for this interference with the value of this land.

The Case of a Forced Landing

Another incident of this interference of power wires with aviation occurred near the town of Brighton in New York State. In the outskirts of the town power wires of the Rochester Gas & Electric Co were carried on 50-ft steel towers. A pilot was flying from Penn Yan to Rochester and the engine of his plane stalled at ten o'clock at night within three or four miles of the Rochester Airport.

Attempting a forced landing his plane crashed into one of these towers, wrecking the structure. The power company sued, maintaining that the pilot had been negligent.

When the airplane came into contact with the top of this tower the rights and responsibilities of the parties were exactly the same as they would have been had the plane come in contact with the earth below, said the New York court deciding in favor of the power company. Air navigation, important as it is, cannot rightly levy toll upon the legal rights of others for its successful prosecution.



To hold that the pilot of this plane was absolved from liability because he was himself free of negligence would jeopardize all the chimneys in the land as well as livestock on the farms and even the people in their homes.

Whatever chance there may be that a properly equipped and well handled airplane may crash upon and injure private property, concluded the court, must be borne by him who takes the machine aloft.

Presence of Airport Cannot Affect Use of Adjacent Land

In an Indiana incident the court followed this same principle of law that is thoroughly established. The owner of an airfield near Indianapolis attempted to secure an injunction against the maintenance of power lines by the Indianapolis Power & Light Co. at approximately 200 ft outside the boundary of this field. These wires were carried on towers 90 ft high and set about 400 ft apart.

The owner of the flying field complained that planes could not leave nor land without flying low over the adjacent land and in doing so were obstructed by these transmission lines and the danger from wires carrying 132,000 v.

The establishment of an airport in no way affected or limited the right of the adjacent land owners to use their land in any manner or for any purpose for which they might have used it before, asserted the Indiana Supreme Court.

Had the owner of the land chosen instead of transmission towers, to erect flag poles, factory chimneys or tall buildings across the whole of its land and several times as high as its power line it would have been within its rights notwithstanding that it might by so doing have entirely prevented the landing of airplanes at this airport.

The flight of an airplane across its land at such a low altitude as to interfere with the land for the purpose of maintaining a power line, this court held, is unlawful and the law cannot be construed to require a power company to guard against this unlawfulness any more than to guard against the unlawfulness of a trespasser who climbs the towers and thus comes in contact with its wires.

The power line interferes with none of the rights of the owner of the flying field and the power company owes no duty to protect the public against dangers which cannot reasonably be anticipated.

"The owner of property," concluded the court, "is under no duty to keep premises safe for a trespasser who comes without enticement, allurement or invitation."

References

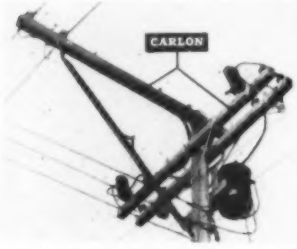
United States v. Causby, 328 U.S. 256.
Rochester Gas & Electric Co. v. Dunlop, 266 N.Y.S. 469.
Capitol Airways v. Indianapolis Power & Light Co., 18 N.E. 2d 776.
Strother v. Pacific Gas & Electric Co., 211 Pac. 2d 624.

PRACTICAL HINTS AND KINKS

PLASTIC PIPE FOR INSULATED RACEWAY ON POLE LINES

SEVERAL UTILITY COMPANIES in central New York State have found both flexible and rigid plastic pipe to be well suited for use as raceway for pole line wiring. Enclosing of pole top wiring in this pipe protects linemen from high voltage, particularly during damp weather, and prevents wires from tangling in their hooks. One company tested this pipe to determine at what voltage it would break down and found it withstood more than 20,000 volts.

Other benefits found were: it was easy to handle, lightweight and suitable for stapling to poles. Being flexible, it can be bent to form a drip loop to permit escape of rain and melted snow and ice. Because the interior of this pipe is smooth, wires can be pushed through it easily. The manufacturer guarantees it against rot, rust and electrolytic corrosion and assures long service life despite the severe conditions to which it is exposed in pole top installations. Another advantage reported is the fact that it can be stored easily in a warehouse.



View of pole top showing installation of plastic pipe

The plastic pipe shown in the illustration is manufactured by the Carlon Products Corporation, Cleveland, Ohio.

HEATING CABLE KEEPS RUNWAYS FREE OF SNOW

OUTDOOR CRANE and transport runways can be kept clear of snow by means of heating cable. An application at the South Milwaukee plant of the Bucyrus-Erie Company proved this. They installed 40,000 ft of General Electric lead-covered heating cable in four concrete runways ranging in length from 100 to 275 ft. The flexible cable was laid on wire mats about three inches below the surface and on approximately three-inch centers. Tile drains were provided along the edges of the runway for drainage of the melted snow.

One of the four concrete runways kept clear of snow with heating cable

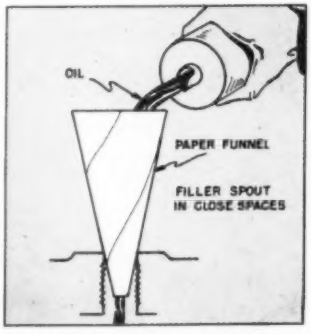
Step-down transformers were used to supply proper voltage to the varying lengths of cable runs.

The heating cable met its greatest test after a weekend snowfall. Even with the outside temperature at eleven degrees below zero, the cable was able to clear the runways in a few hours.

PAPER FUNNEL USEFUL IN EMERGENCIES

By B. W. KENNEY

FILLER spouts on tractors, hydraulic lifts, and many machines of various types, are often located in close quarters. Because of this, it is almost impossible to pour oil in without the help of a suitable funnel.



View showing how to use paper funnel in an emergency

When a regular metal funnel is not available, a paper funnel may often be used to advantage, saving time as well as oil. Wrap a strong piece of paper, or thin cardboard, spirally to form a long cone or funnel. It can be held in shape and position with one hand while the oil is poured from a container with the other. After use, the paper can be discarded.

INSULATION TESTER

IN CASE a megger is not available, insulation resistance measurements may be made easily by using a 500-v d-c circuit and a 500-v d-c voltmeter. The method of measurement is to first read the voltage on the line; then connect the resistance to be measured in series with the voltmeter and take a second reading.

The measured resistance is then calculated by using the following formula:

$$R = \frac{r(V - v)}{v(1{,}000{,}000)}$$ in which

V = voltage on the line

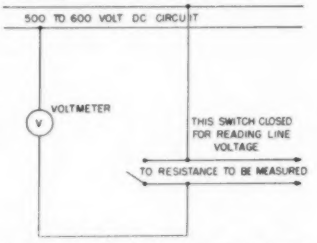
v = voltage reading with insulation in series with voltmeter

r = resistance of voltmeters in ohms (generally marked on label inside the instrument cover)

R = resistance of insulation in megohms (1,000,000 ohms)

The method of connecting the apparatus is shown in the diagram.

If a grounded circuit is used in making this measurement, care must



Wiring diagram showing how to connect voltmeter for measuring insulation resistance

be taken to connect the grounded side of the line to the frame of the machine to be measured, and the voltmeter between the windings and the other side of the circuit.

Voltmeters having a resistance of one megohm are now made for this purpose so that, if one of these instruments is used, the calculation is somewhat simplified. Since r = 1, the formula becomes:

$$R = \frac{V}{v} - 1$$

A safe general rule is — insulation resistance should be approximately 1 megohm for each 1000 volts of operating voltage with a minimum of 1 megohm.

No new machine should have an insulation resistance of less than 1 megohm.

IMPROVING THE TANK CUTTER

By G. F. O'RILEY

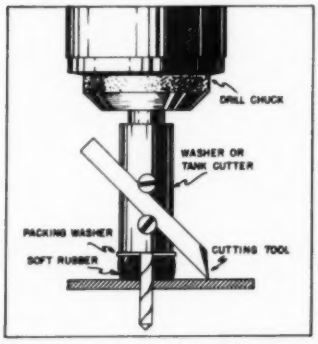
THE TANK CUTTER is used for cutting holes in the walls of sheet metal tanks and for cutting out washers from sheet metal. One simple form of cutter comprises a circular shank to which is attached a cutting tool whose radius is adjustable by sliding it up or down in the groove in the

shank. See sketch. A twist drill is incorporated in the end of the shank and serves to drill a hole at the center of the required circle. It also acts as a pivot about which the tank cutter can rotate.

Single tool tank cutters are simple and work well when used in a portable electric drill or hand brace. However, trouble is apt to be encountered when the cutter is breaking through the bottom surface of the sheet. This trouble appears in the form of snatching and digging in of the cutting tool and is due to the lack of control over the feeding of the tool. Heavy pressure will stop the tool completely and too light feeding pressure will prevent the tool from cutting.

One solution to the problem is to slip a ring of soft rubber over the drill; the thicker the better. This ring allows a constant feeding pressure to be applied to the tool. The pressure applied must be sufficient to compress the rubber ring and allow the cutting tool to make contact with the metal to be cut. In this way, the actual feeding pressure applied to the tool can be nicely controlled.

In the tank cutter shown here, the downward projection of the cutting



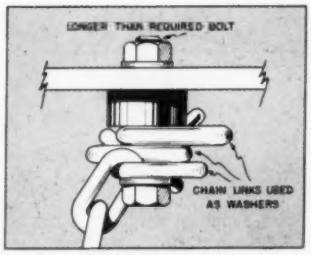
Tank cutter in use showing its construction and how rubber washer is used

tool varies as the radius cut is altered. To ensure that the rubber washer is absorbing some pressure at the start of a cut, the distance between it and the work surface can be adjusted by threading washers on to the drill. This technique is applicable to most washer and tank cutters which use one or two cutting tools.

CHAIN USED AS WASHER IN EMERGENCY

By K. W. THOMAS

LOGGERS, road builders, gas line workers, etc. while working in remote areas, often find it necessary to make emergency repairs involving the use of bolts and various binding devices. Also, in such jobs it may be impossible to obtain bolts of the exact length desired. When this problem arises it is often necessary to put washers on the bolt as spacers. On



Example showing how chain can be used as a washer for spacing long bolts

several occasions, I have solved such problems by using a length of chain as washers as shown in Fig. 1. If several bolts longer than required are used in an emergency, a single length of chain may accommodate all of them without being cut in pieces. Thus, the chain is saved for future use when the emergency is past.

KEEP DIESEL FUEL CLEAN

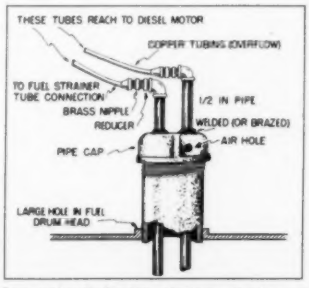
By W. B. KENNEDY

DIESEL engine sets are often used on temporary, un-sheltered sites. Whether one fuel tube or two is used, it is desirable to have protection against rain, dust, trash, etc., where the fuel tube or tubes enter a regular drum, tank or other type of fuel container. Figure 1 shows how one operator solved the problem.

In this case, regular steel drums served satisfactorily as fuel containers because the runs were not long.

A short length of pipe was threaded into the larger hole in the drum head. Two holes were drilled through a regular pipe cap of suitable size. Lengths of $\frac{1}{2}$ in. pipe were welded in place in these holes. Elbows, reducers, brass nipples, and tube connections made it possible to connect fuel tubes to this protective arrangement. Notice that the brass nipple was used between the iron pipe and the copper fitting to prevent electrolytic action. An air hole was drilled in the pipe cap at the side.

In shifting to a fresh drum of fuel, it is only necessary to disconnect the tubes, and remove the larger pipe from the drum opening, while the smaller pipes and cap remain intact.



Cross-sectional drawing showing assembly of weather-proof fuel tank tap

This arrangement provides ample protection and is not too troublesome in shifting to another drum. Of course, the air-hole plug remains in the drum. Only the larger drain plug is removed as air is permitted to enter through the small hole in the pipe cap while fuel is being drawn from the drum.

THE MAGIC FORMULA FOR RUSTY THREADS—H_2O

BY H. B. McDERMID

BOLT THREADS, after long service, often rust and dry so that it is nearly impossible to loosen a nut without twisting off the bolt.

As any experienced mechanic knows, threads should be lubricated before being joined. But sometimes they are not.

Penetrating oils have been used in such situations, but they are relatively expensive and often the mechanic doesn't have them on the job. There is a remedy, however, that is relatively unknown to most mechanics, but is almost universally accessible and inexpensive — ordinary cold water.

Strange—But True

The proposal of such a remedy will often bring a pitying smile to the face of a mechanic. But strange as it may seem, soaking of rusted pipe or bolted joints in water loosens these joints, and when properly done, comes mighty near beating other and more expensive methods, even when both are readily accessible.

This method was brought to my attention by a retired repair man who had worked for many years on domestic heating furnaces. Here, the threads involved are generally under $\frac{1}{4}$-in. The working conditions are usually very dry, so when rust forms, it anchors the threads firmly enough to cause destruction of the stove bolts when trying to loosen the nuts.

Bottle of Magic Formula

This old mechanic had wonderful luck with his bolt work. He always carried a bottle of "magic formula" whose secret composition he would never reveal. His friends knew his success depended upon the contents of the bottle, but no amount of coaxing would get the old fellow to give up its secret. One day, after successfully loosening many rusty dry threads, the old mechanic sneaked off to replenish his stock of "magic formula." That day the carefully guarded secret was revealed. He was caught — at the water faucet!

Skeptical like the rest, I nevertheless tried the water treatment fairly, and found it all the old mechanic had said. It has helped in many a bad spot.

Rusted Outrigger Jacks

One example comes to mind. When I worked at a boat yard run by the War Department, another yard shipped in a dis-assembled

mobile gasoline-engine-driven crane. Mixed in with the parts were four outrigger jacks with 3 x 18-in. U. S. coarse threads. They were as badly rusted as iron could be and seemed a total loss — beyond reconditioning.

But we soaked the jacks in a fresh water forebay of a nearby hydroelectric plant overnight. Next morning we hauled them up, laid them on the ground with only a pipe wrench to prevent turning, and put a 36-in. stillson on one of the nuts.

It took just one good yank to break the nut loose from the bolt threads!

After we had run the nut the full length of the bolt thread twice, we washed off the loose rust, dried the jacks well, thoroughly oiled them, and the reconditioning job on the threads was nearly perfect.

One Caution

Don't soak a rusted joint and then allow it to dry again before trying to break the nut loose. Instead, use the wrench while the rust is still wet, and the nut will break loose easily.

ANOTHER VOLTAGE PROBLEM WITH WELDERS

By C. T. BAKER

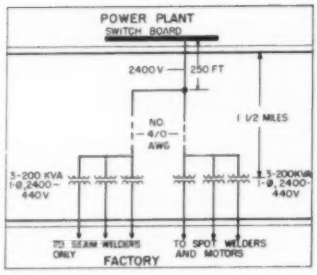
A SHORT TIME AGO, I was retained by the management of a municipally owned power generating and distributing system to investigate the complaints of a large power user. These people claimed serious difficulty in maintaining plant output because of widely fluctuating and, at times, low voltage.

Their plant manufactures cylindrical steel tanks which are subjected to rigid pre-shipment tests for leaks, required by the purchaser. Both the circumferential and longitudinal seams of the tanks, which are made from sheet steel are arc-welded. Voltage checks were made with a recording and an indicating voltmeter on the interior circuits which serve the 250 kva and 150 kva seam and spot welders. Each is supplied with single-phase, 60 cycle current. The larger welder is equipped with a capacitor but the smaller is not. An interlock switch is installed to prevent the two spot welders from being started simultaneously.

Primary voltage delivered by the power station to the two transformer banks was 2400 v. Secondary voltage for all uses, except welding machines, was 440 v. The voltage for the seam welders was reduced from 440 to 27 v.

Thirteen seam arc-welding machines were installed, served by three-200 kva transformers. The total connected motor load in the factory was 1350 hp. Voltage readings, as recorded, showed a variation of 10 to 15 per cent on both the primary and secondary circuits supplying the seam and spot welders.

Because of the capacitors with which the 250 kva welder was



One-line diagram of power system

equipped, its voltage regulation was far superior to that of the smaller unit. At times, the change in voltage on the smaller unit amounted to 60 to 65 volts, while fluctuation seldom exceeded 10 volts on the larger.

Included in the various complaints by the management of the tank plant was inadequate heat penetration during seam welding operations. This, they contended, was one of the contributing casues of rejects by the customers, and it seriously increased their cost of production.

Current was supplied to the factory from the power station over two No. 4/0 circuits $1\frac{1}{2}$ miles long. However, these two circuits were not directly connected to the station switchboard. A single No. 4/0 circuit extended from the power station to a point some 250 ft distant where it tied to the duplicate circuits. One was connected to the primary of the transformers suppling the seam welders and the other to the primary of the transformers supplying the spot welders. See Fig. 1.

The following steps were taken to improve conditions. The power station transferred all users, other than the tank plant, to other circuits. This was the first move possible and while it did not completely overcome the trouble, it materially improved conditions. The second step was the installation of induction voltage regulators at the seam welding transformers. The final step was the installation of a capacitor on the smaller spot welder. After these improvements and additions to the equipment in use were completed, the trouble from poor voltage regulation and long intervals of low voltage soon disappeared.

"Have you tried soaking it in hot soapy water?"

Questions and Answers

Q & A—THE POWER ENGINEER'S FORUM—

HERE'S HOW IT WORKS

YOUR QUESTION about some problem in operation, maintenance or design will be published, signed only with your initials.

Answers to your questions from other readers will be sent you as soon as received, then published as space permits, so that all may have the information.

You, too, answer questions from other engineers in the same way. You get paid well for published answers and also get the credit for knowing them.

If other engineers help you solve your problem, you express your thanks, via the Q & A editor.

Simple, isn't it. And effective! Just ask engineers who have tried it!

Question No. 494

WHAT'S THE RIGHT WAY TO TAKE FUEL OIL SAMPLES?

OUR POWER PLANT has always burned coal but now we are going to install combination gas and oil burners in our furnaces over our stokers so we can change back and forth to take advantage of price changes, and supply conditions. Three-fuel operation will solve a number of problems for us, although coal will remain our base fuel, I expect. The gas burning and gas supply give us no problems. We'll do many of the things advocated in the April 1951 issue of POWER ENGINEERING.

We will use a return-type oil burner system, with suitable pumps and heaters and two 5000-gal oil storage tanks. We will use No. 6 oil and will have proper flow meters and thermometers installed.

Now, after reading Mr. Engelman's Basic Power Plant Figuring article on Fuel Oil in the December issue, I think I will not have too much trouble in figuring oil volumes and heat contents, specific gravity, and other things, to find out just how many Btu I'm putting into the boiler per hour. Mr. Schmidt's Fuel Oil articles are also extremely practical and helpful.

All in all, looks like we'll be in good shape all except for one point: — Nobody has yet mentioned what I've got to do to get proper oil samples. We're going to have a testing laboratory do the tests. I suppose the laboratory will tell me what to do about samples.

But until they do, I want some first-hand knowledge of oil sampling:

1 — What equipment must I have for taking oil samples?
2 — How is it used: in car or pipelines, in the heater system or where?
3 — At what points should I take my samples?
4 — What containers should I use — and how do I ship samples to the lab?
5 — Are any special piping and valve arrangements needed? If so, how are they arranged in the oil system?

Is oil sampling a very simple thing I should be expected to know all about? Or are there some tricks in it I must learn, so the lab can get good tests and I can keep accurate records, so my steam costs will figure out with reasonable accuracy in comparison with the other two fuels?

I'll be grateful for any help Q & A readers can give me.

Chicago, Ill. AMBITIOUS AL

Question No. 495

HOW CAN HE STOP DIRTY SPRAY FROM BLOW-OFF TANK VENT?

I HAVE TO design a couple of boiler blow-off tanks for our company. In doing this, I must provide for discharge of nothing but clean dry steam from the blow-off tank vents. Reason for this is that on another existing blow-off tank, the discharge from the vent was like a dirty rain storm, leaving black spots on everything around it where the drops landed.

My problem, therefore, is this: —

1. Can I separate the water from the flash steam discharged from the vent by design of a plain tank?
2. Should a separating device or chamber be built into the tank?
3. Should an exhaust separator be installed on the outlet end of the vent pipe?

The existing tank that sprayed the surroundings with dirty rain was built as in Fig. 1. The vent pipe ran up from the top of the tank through some 80 ft of vertical pipe, then, through the building roof. The blow-off discharge into the tank apparently set up a violent storm in it.

So the original blow-off tank of Fig. 1 was modified as in Fig. 2. The perforated pipe was bent in an arc and supported by brackets around the tank wall, with a deflector plate above the pipe. A cage of perforated steel plate was built around the en-

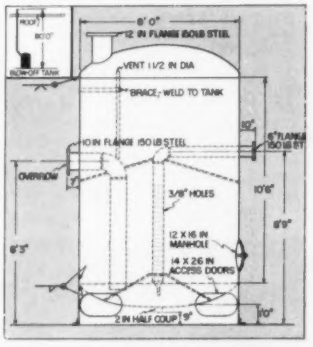


Fig. 1. Here is the original blow-off tank that sprayed dirty water through the vent

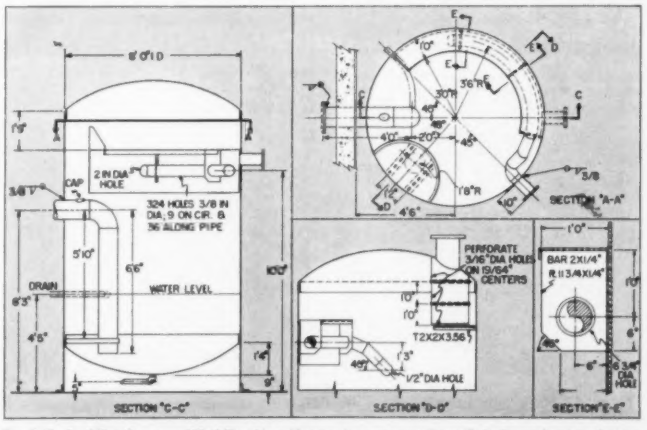


Fig. 2. Tank of Fig. 1 was modified like this, with some improvement, but still discharged too much dirty spray through vent. What can be done to improve it still more?

trance to the vent pipe and a small supplementary drain was installed to lower the water level in the tank. Although these changes made some improvement, still too much dirty water is carried out the vent pipe.

Now, in designing two new blow-off tanks for our company, I want to improve them still more, if possible. I have good data on the general design of blow-off tanks for size and construction, but I still have this problem of the dirty spray discharging from the vent. How can I solve it?

Los Angeles, Calif. H.T.L.

Answer No. 477

WHAT IS BEST HEATING SYSTEM FOR A CHURCH?

REMEMBER all the interest in this question, which was first published 'way back in the January 1951 issue? Many engineers — Wright, Eckert, von Dannenberg, Tatman, Evans, Andrews and others — gave good practical advice in the March, April and June issues, based on their own personal experience with their own churches or those they knew about.

Anyway, there was a lot of interest in the problem, and just recently we received the following pictures and data on how they did it in a brand new church. In this case, at Mooseheart, Ill., they used radiant heating. (Incidentally, there are many methods of heating big churches and cathedrals and among them radiant heating has been used for many years, usually in combination with other methods.)

Fig. 1. Children's Cathedral at Mooseheart, Ill. is first all-children's church and first civilian church to provide service for all faiths under one roof

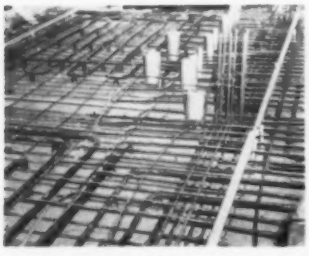


Fig. 2. Radiant heating piping to be embedded in structural slab of Mooseheart Children's Cathedral, showing A-shaped strap-iron supports to hold wrought-iron pipe proper distance above concrete form work

CHILDREN'S CATHEDRAL is another addition to the famed city of Mooseheart, Illinois, founded and operated by the Loyal Order of Moose and maintained by it for the care and education of deceased members' children. The Cathedral is one of the largest churches in the country to use radiant heating, it is claimed, and is the third largest installation in Mooseheart.

How They Heat the Children's Cathedral

Nearly 7 miles of 1½-in. wrought-iron piping (over 46 tons) was laid in the church floor to provide circulating hot-water heated panels. Steps leading to the three altars are also heated with embedded pipe. Structural floor slab is made of insulating concrete to prevent excessive heat loss to the basement and ground, and out the slab edges to the atmosphere. Footings and transverse stringers, made of pipe, supported the heating grids and coils until the floor pad was poured.

The building contains five separate heating zones, each with an outside master control (combination thermometer and barometer) as well as an inside thermostat. The outside master anticipates climatic changes and adjusts its system so there is no lag in the inside temperature.

When an outside change in temperature occurs, the master control takes over and supersedes the work of the inside thermostat. Thus, the inside temperature is compensated for changes in weather without the usual delay caused by insulating effect of the walls.

Heat for the church comes from the central plant in the form of exhaust steam from the electric generating units. It is carried through a tunnel to the converters located in the church basement. Here, modulating valves at the converters regulate the amount of hot water introduced into each system to control heating effect of the various panels.

Each zone has its own circulating pump and five spare units are installed as standbys in case of main pump failures. Steam converters and control equipment are mounted on the basement ceiling and walls to provide a maximum amount of free floor space for storage.

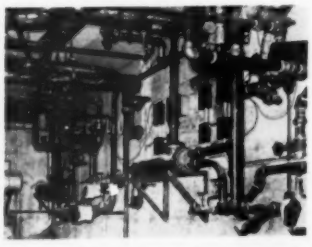


Fig. 3. Steam converters, circulating pumps and control panels on basement walls of Children's Cathedral at Mooseheart. Steam for water heating comes from institution's power plant

Answer No. 479

Q & A READER SOLVED COAL-HANDLING PROBLEM

IN the February 1951 issue, H.E.F. said that his company had two small plants, at each of which they want to maintain a reserve stock of about 600 tons of coal (approximately two month's supply). However, this coal is screenings and having high moisture content they have had considerable trouble in handling, feeding and burning it.

What should they do? Obviously an extensive coal conditioning and handling system would cost too much.

For several months, Q & A readers discussed this problem, which has been encountered in so many plants. Among others, Donald M. Given of Fairmont Coal Bureau gave some very definite and practical advice in the June issue.

Now H.E.F. wants to thank Mr. Given for his practical help and to report that Mr. Given's suggestion of mixing the wet coal with dry coal solved his problem.

This mixing of wet and dry coal is becoming a fairly well-known trick in handling wet coal. By doing so, you reduce the surface moisture to a value low enough so the coal will not clog in chutes, conveyors and other handling equipment. Of course, you've got to get some dry coal to do it with, but that is not impossible.

Important thing here is: this is just one more case, among many, in which the practical advice of a Q & A reader solved another engineer's problem. That's what the Q & A section is for.

Answer No. 490

WHAT CAUSES POINT ON STEAM ENGINE INDICATOR DIAGRAM

Comments by Brown

THE PEAK is probably caused by a little too much lead on the head end. It is also possible for this to be caused by a large steam chest and a small steam line, causing admission at near boiler pressure. This dropping immediately a 12 in. steam line would practically eliminate this possibility.

All taken into consideration it is not serious but it can be corrected by reducing the lead on the head end and checking with indicator cards until it is correct.

Computation of Ihp using a planimeter

H.E. − M.E.P. = 58.3 psi
C.E. − M.E.P. = 65.8 psi
Ft per min. = 800

H.E. piston area = 908.12 sq in.
C.E. piston area = 876.33 sq in.

$$Ihp = \frac{62.05 \times 800 \times 876.33}{33{,}000}$$

Ihp = 1318

Cincinnati, Ohio ROY M. BROWN

Any way you figure it, corrosion of steam and condensate lines is a serious problem . . . and a costly one! Replacement of corroded lines, interrupted production, increased labor and maintenance send costs spiraling far beyond the limits of economical plant operation. But something can be done about it *right now*, with complete assurance of satisfactory results.

Take the case, for example, of a large plastics molding plant which operated the cycle on its molding machines alternately with steam and oxygen-saturated cooling water. Under these conditions, severe corrosion resulted. Check valves on the steam supply lines to the machines had an average life of only one week—*sometimes even less!* Costs were skyrocketing.

Here's what Betz did about it. By applying its patented filming amine treatment, piping and valve losses stopped *immediately!* After three years' treatment with this advanced technique, satisfactory corrosion control continues. What's more, plant records show savings in labor and maintenance have averaged 30 times the cost of the treatment applied.

This is just one example of how Betz Engineers help keep plants *like yours* at peak operating efficiency. Why not get in touch with Betz today as the first step toward solving your particular water problems. There's no obligation, of course. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

For the full facts and figures on how BETZ is solving return line corrosion problems in plants like yours, write today for Technical Paper No. 124.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

World's Largest Turbine Pumps Relieve New York City Drought Danger

DRASTIC curtailment of water consumption for the citizens of New York City in 1949–50 may not be repeated in the near future because the new Hudson River Pumping Station has been completed. The drought in the New York City watershed in 1949 speeded the city's Board of Water Supply to seek an additional source of water to meet current as well as growing future needs. The Hudson River, 10 miles north of Beacon, N. Y., was selected as the source to tap. The new pumping station is to discharge into the Delaware-West Branch conduit. This is a completed portion of the great Delaware Aqueduct project now under construction.

Capacity of this new station is 100 mgd and its life is limited to five years, so that it can be superseded by the Delaware Aqueduct supply when the aqueduct is completed. The output of this station, when needed, will be mixed with seven times its output of upland watershed water. No treatment other than superchlorination is considered necessary, for the saline content of the water is low.

Figure 1 shows the general layout of the station plot. Water is withdrawn from the river through a conduit, discharged from the station into Shaft 6 and into the Delaware Tunnel. The tunnel carries the water directly into the City's reservoirs.

Electric Equipment

Electric equipment, supplied by the General Electric Co., includes: six 2500-hp, 900-rpm, 400-v, 3-phase, 60-cycle, 1.0 pf vertical, synchronous motors; one 15,000-kva outdoor substation, consisting of two 7500-kva transformers with 110-kv primaries and 4160-v neutral resistance-grounded secondaries; magnetic starting equipment for each of the pump motors, which limits the inrush current to not more than 10,000 kva; and a 250,000-kva IC circuit breaker with time-delay-undervoltage, overload and short-circuit protection for each motor.

Pumps

The six pumps manufactured by the Peerless Pump Division, Food Machinery and Chemical Corp., shown in Fig. 2, are the largest of their type in the world. They are vertical, close-coupled turbine pumps, rated 2500 hp, 14,000 gpm at 600 ft head. These pumps easily meet the specifications, which require that they be designed for a rated head of 575 ft, but suitable for operation at any head between 525 and 625 ft. Also, each must be of a capacity equal to 100 mgd divided by one less than the number of pumps installed, at 600 ft head. The pump bowls are 36 in. in diameter and the discharge is 24 in. in diameter.

Control System

The connection between each pump and the discharge header contains a 20-in. conical plug check valve, a tee with a branch containing a 10-in. gate valve and Pelton surge suppressor, and a 24-in. motor operated gate valve.

Automatic controls provide a fixed sequence of valve operation when starting and stopping the pumps normally, also in an emergency such as a power failure. Before a pump can be started, the following conditions, controlled by electric interlocks, must be fulfilled: (1) the discharge header is under pressure from the tunnel, the control signal coming from a pressure switch connected to the header; (2) the accumulator tank of the oil system, operating the 20-in. cone valves, is up to pressure and the oil is at operating level; (3) the 24-in. pump discharge valve is open; (4) the 36-in. cone valves at Shaft 6 are open. When starting, the motor is brought to full speed and synchronized before the 20-in. cone valve starts to open. It takes this valve 2 min to open. In closing, when the stop button is pressed, the cone valve starts to close and when closed, a limit switch stops the motor.

In an emergency shut-down due to a power failure, all the cone valves close in 9 sec, and all the surge suppressors open in 1 sec, simultaneously disconnecting the motors. When there is a loss of control voltage, the cone valve and surge suppressor on the affected circuit function and stop the motor. If there is an electric failure of the motor or starting equipment, all the suppressors open if the line pressure drops below the setting of the pressure switch.

Surge Suppressors

Opening of any surge suppressor will cause its respective check valve to close in 9 sec and disconnect its motor. The surge suppressors are equipped with spring-loaded relief valves set to open the surge suppressor whenever the pressure in the discharge conduit exceeds 700 ft. A hydro-pneumatic accumulator maintains sufficient pressure for quick opening of the surge suppressors even though an abnormal decrease in pressure occurs in the discharge conduit following an emergency shut-down.

The pressure switch on the discharge header, which operates the surge suppressors when subnormal pressure occurs, is set to open contacts at 157 psi with falling pressure and close contacts at 174 psi with rising pressure.

The discharge pipe from the pumping system into the Delaware Aqueduct, is at the Shaft 6 drainage chamber. This pipe enters the Shaft 6 drainage chamber and divides into two branches. Each branch has a 36-in. conical check valve for emergency closure in case of a sizable break in the discharge pipe. A 16-in. line from the first branch, and connecting with an existing stilling chamber, contains a gate valve and a pressure relief valve for pressure control and surge suppression. The cone

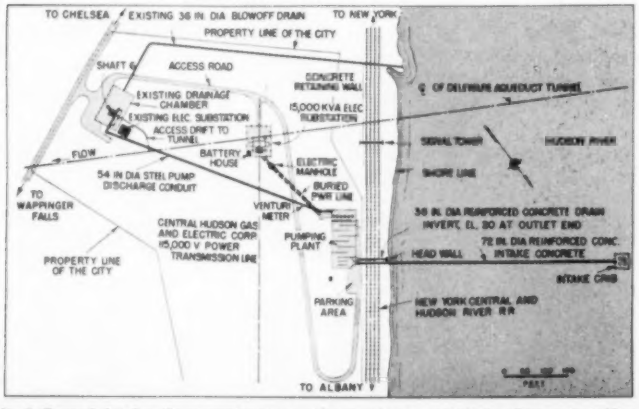


Fig. 1. General plot plan of new pumping station at Beacon, N. Y. to supply Hudson River water to New York City's water system

Best in it's Field!

A DEAERATING HEATER—Two-Stage Jet Tray Type

K DEAERATING HEATER—Atomizing Spray Type

Q DEAERATING HOT PROCESS WATER SOFTENER—Make-up 100%

J DEAERATING HOT PROCESS WATER SOFTENER—Makeup 50% or more

10 DEAERATING HOT PROCESS WATER SOFTENER—Makeup 50% or less

American

Full-Line Equipment For Better Water Treatment

American's "Full-Line" of Deaerating Heaters and Deaerating Hot Process Softeners combine the most advanced developments in water treatment gained from an experience of half a century in successful water engineering!

Feature for feature, this American equipment outperforms comparable equipment in . . .

- *Alkalinity Reduction*
- *Silica Removal*
- *Oxygen Removal*
- *Solids Reduction*
- *Hardness Reduction*
- *Uniform Effluent under all types of operating conditions*

American recommendations are determined on a basis of offering equipment best suited for a particular application. There is no softening or deaerating requirement that an American system cannot accommodate more efficiently with an assurance of a safe, uniform economical boiler feed.

Invite American Engineers to survey your water requirements—be assured of sound, impartial recommendations—without obligation.

CELEBRATING OUR FIFTIETH YEAR!

AMERICAN SYSTEM A W S Co. PATENTED

The AMERICAN WATER SOFTENER COMPANY

LEHIGH AVENUE & FOURTH STREET • PHILADELPHIA 33, PENNA.

FILTERS • SOFTENING SYSTEMS • CHEMICAL FEEDERS • ION EXCHANGERS • RE-ACTORS • SWIMMING POOL EQUIPMENT • DE-GASIFIERS • WATER TEST SETS • RE-CARBONATORS • ALKALIZERS

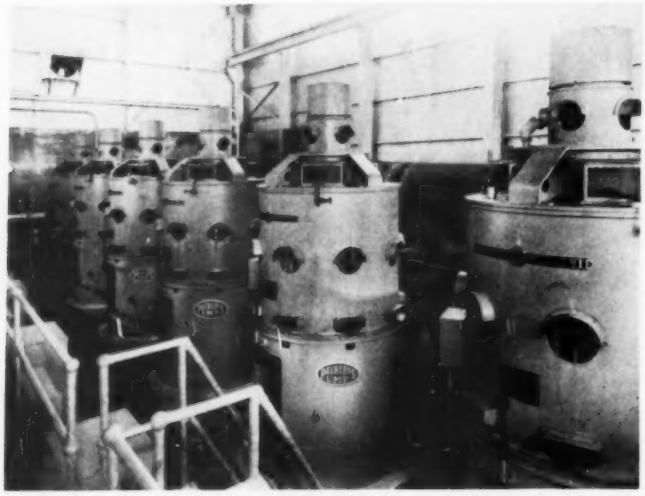


Fig. 2. View of the six turbine pumps in new Beacon pumping plant, capable of supplying 100 mgd to New York City

check valves are operated by oil pressure.

A pitot-tube control will close the check valves in 15 sec if the reverse flow in the conduit exceeds 10 fps. If the resulting pressure in the shaft cap and riser exceeds 650 ft, a pressure switch will automatically open the pressure relief valve. The dashpot in this valve is arranged to close the valve in 15 sec when the pressure drops to normal. Limit switch connected to indicator lamp indicates if equalizer air valves are closed.

The two 36-in. cone check valves are opened by a hand valve in the oil line and can be closed from the pump room by a push button. This enables the operator to close them for reverse flows in the discharge conduit of less than 10 fps. Limit switches on these valves prevent starting of any pump if either valve is closed.

A 5-in. line connecting the top of the shaft cap and the discharge conduit, and controlled by a hand-operated valve, is provided for filling the conduit initially.

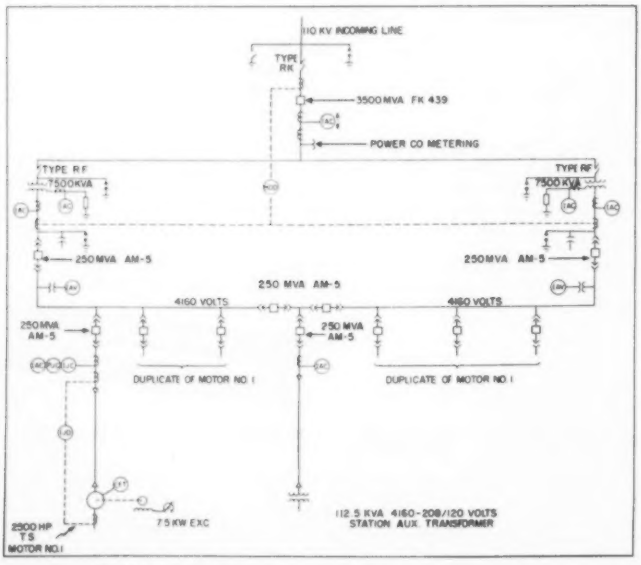


Fig. 3. One-line diagram of power circuits at new Beacon pumping plant

PLANS FOR 1952 CENTENNIAL OF ENGINEERING AT CHICAGO

American and foreign engineering societies will join ASCE to celebrate its 100th anniversary. . . . Designed to demonstrate to public the ways in which engineering has contributed to the progress achieved in that time. . . . Over 25,000 engineers expected to attend 11-day conclave in September 1952. . . . Exhibits will show Century of Engineered Progress.

WITH 51 American and foreign professional engineering societies already committed to the greatest convocation of engineers in history, the American Society of Civil Engineers has announced its plans for celebration this Fall of its 100th anniversary, culminating in an 11-day conclave of some 25,000 engineers and guests in Chicago.

Joined with it in pointing toward the September convocation are its four associate Societies, all members of the Engineers Joint Council: American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers and American Institute of Chemical Engineers. Grouped now with these in the plans for the conclave are more than forty other engineering organizations. Many foreign delegations have sent in their announcements of participation.

Organization Details

The Centennial of Engineering, 1952, Inc., is an over-all corporation for the organization and control of the Centennial Celebration. It is a special, non-profit corporation from engineering and industry with Charles F. Kettering, director and consultant of General Motors, as Chairman of the Executive Committee. Its President is Lenox R. Lohr, who is also President of the Museum of Science and Industry in Chicago, where, as one phase of the celebration, it is planned to establish a long-time exhibit depicting the "Century of Engineered Progress." Mr. Kettering is an honorary member and Major Lohr a member of the American Society of Civil Engineers. They and Colonel Carlton S. Proctor, of New York, President of the American Society of Civil Engineers, constitute the Executive Committee.

Dr. Henry T. Heald, recently appointed Chancellor of New York University, is Chairman of the Convocation Committee. E. L. Chandler, Assistant Secretary of the ASCE, is convocation manager. Frank W. Edwards, of the Illinois Institute of Technology has been appointed general manager of the Centennial.

Further details are available from the secretaries of ASCE, ASME, AIEE, AIM & ME, AICE, headquarters 29–33 West 39th St., New York 18, N. Y.

IMPROVE COAL HANDLING *Three* WAYS...

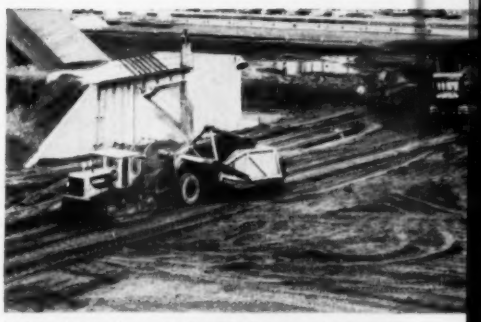
1. **ADD FLEXIBILITY.** Store coal wherever there is available space . . . and reclaim it any time. A-C crawler tractors, equipped with loaders, bulldozers or scrapers travel anywhere . . . over any ground. And in rush periods, you can speed up operations temporarily by transferring additional tractor units to the job.

2. **HAVE EXTRA FIRE PROTECTION.** When A-C tractor units store coal, they spread it in thin layers and compact it by constant travel over the pile. The tight packing of horizontal layers eliminates the flues that cause spontaneous combustion in loose conical piles.

3. **REDUCE EQUIPMENT INVESTMENT.** The Allis-Chalmers tractor method is considerably more economical and flexible than complex conveyor or crane systems — which means savings in original cost as well as lower cost per ton for coal handling. And tractor units can also be used for such jobs as plant and yard maintenance, material handling, car spotting and snow removal.

Send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors." Describes modern coal-handling methods, using A-C tractors and 'dozer blades, front-end loaders and scrapers. Write Allis-Chalmers Tractor Division.

● HD-5G Tracto-Shovel stockpiling coal at a large industrial plant in Cleveland... has averaged 2500 tons a month for a year and a half without ever being down for repairs.

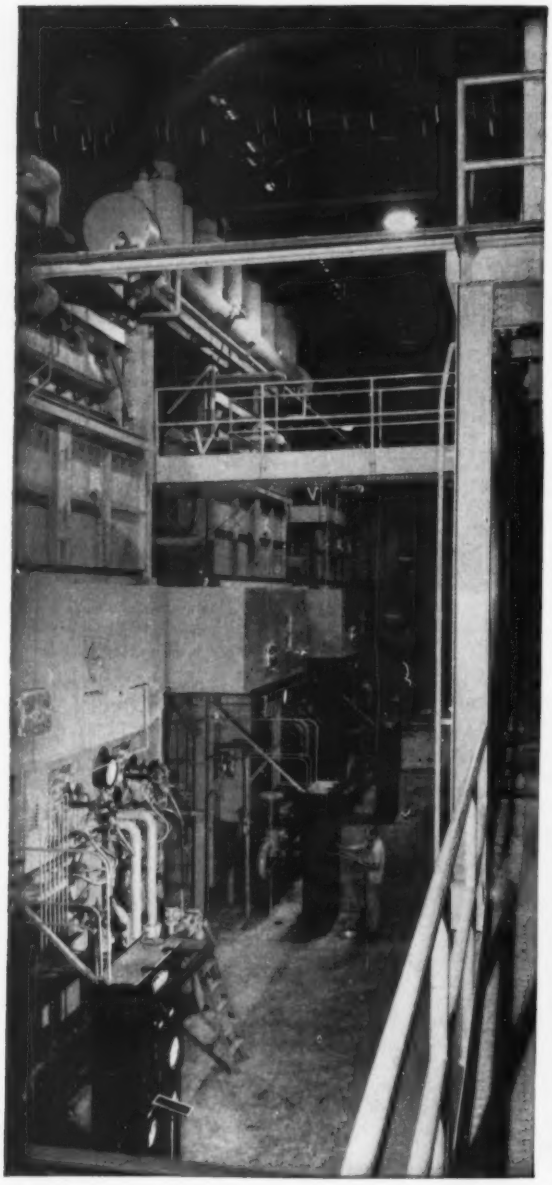


● Four A-C tractors with Gar Wood scrapers bring real flexibility to the coal handling operations of an Ohio utility. They haul as far as 1,700 feet . . . store wherever there is available space.

Four Diesel-Powered Models . . . 11,250 to 41,000 lb.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

COMBUSTION CONTROL



FOR
ALL SIZES OF BOILERS
ALL TYPES OF FIRING
ALL LOAD CONDITIONS

An automatic combustion control system, as designed and built by Republic, will enable you to operate your boiler (or boilers) over a long period at test efficiencies regardless of variations in fuel, load and other operating factors.

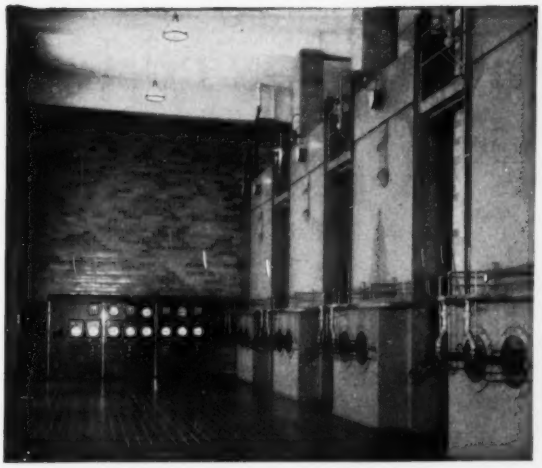
Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler.

It automatically increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

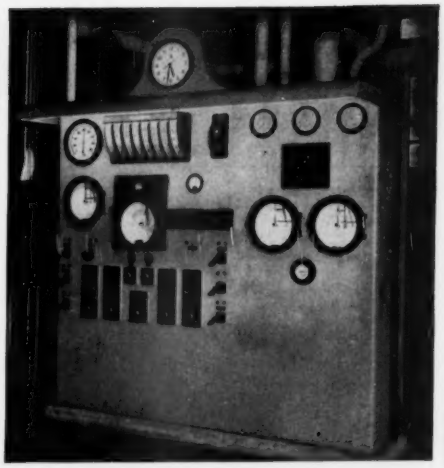
Republic automatic combustion control systems, either pneumatic or hydraulic, are available for all sizes of boilers, all types of fuel firing, and load conditions and any arrangement of draft equipment. They are completely described in Data Book No. S-21—write for your copy.

GAS FIRED—In this modern industrial plant steam is generated at the rate of 400,000 lbs. per hr. by four gas fired boilers operated by a Republic automatic combustion control system.

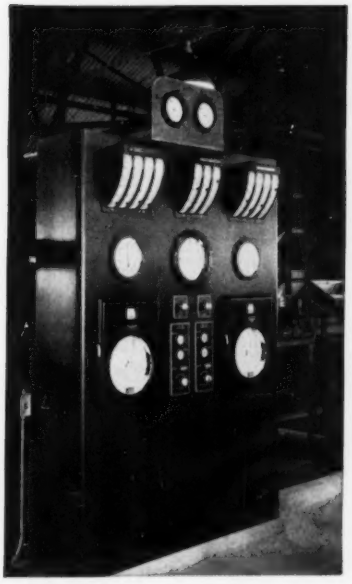
STOKER FIRED—The Republic instrument and combustion control panel for an 80,000 lbs. per hr., stoker fired boiler in a municipal power plant.



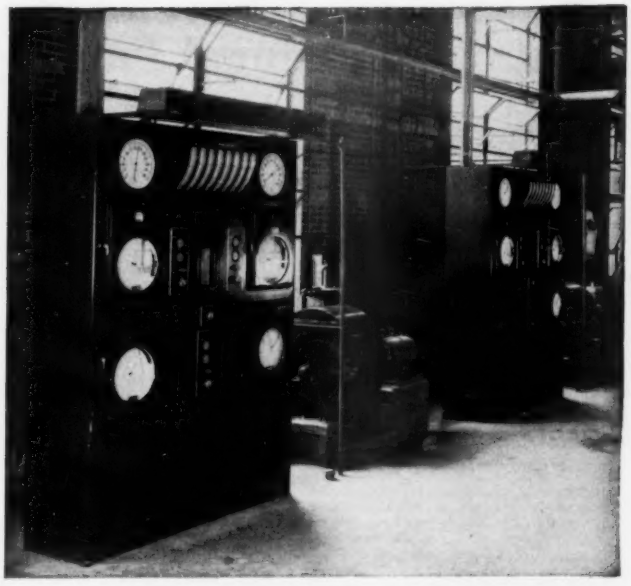
OIL AND GAS FIRED—In this model boiler room of a large institution the four combination oil and gas fired boilers are operated by a Republic automatic combustion control system.



STOKER FIRED—The Republic combustion control and instrument panel for the automatic operation of a 45,000 lbs. per hr. stoker fired boiler.



MIXED GAS—Republic instrument and control panel installed in a natural gasoline plant to automatically control two 50,000 lbs. per hr. boilers burning mixed gas.



STOKER FIRED—A typical Republic combustion control installation in the boiler room of a mid-western university for the automatic operation of two 25,000 lbs. per hr. stoker fired boilers. All boiler instruments and manual controls are centralized on the two panels pictured above.

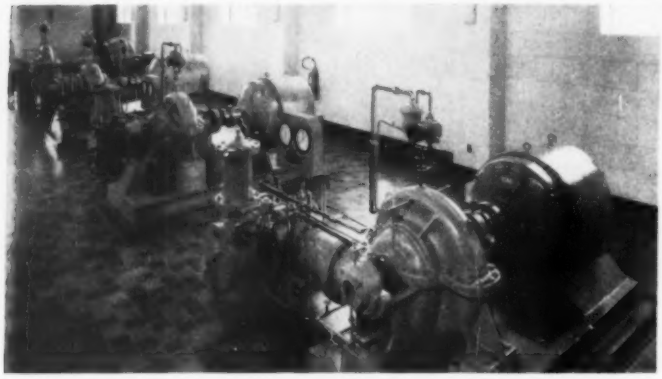
REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

WORTHINGTON

POINTERS ON PUMPS

Prepared for Industry by Worthington Pump and Machinery Corporation



A Plan That Gets the Most out of Centrifugal Pumps

Easy-To-Install Maintenance Program Means Better Performance, Longer Life

You can't get maximum production when your equipment's operation is constantly interrupted due to breakdowns. Moreover, today's equipment shortages make it increasingly more important that you get all the life you can out of your present machines.

We'd like to suggest a maintenance plan that will help you get the most out of one of your most vital pieces of equipment—centrifugal pumps.

Keep Informative Records

If you haven't already done so, it's a good idea to begin your maintenance plan by setting up a card index file so that you can catalogue each pump in your plant. Each card should contain the following information: plant pump number, size, manufacturer's name and style, serial number, date installed, and any other data which will help you to rapidly locate repair parts lists and manufacturer's parts numbers.

The rest of the card can be divided into a number of columns: Repair Date, Part Affected, Remarks, and Cost. A typical card is shown here.

PUMP MAINTENANCE CARD

_____PUMP NO.	_____MANUFACTURER
_____SIZE	_____MFGR'S ADDRESS
_____DATE INSTALLED	_____MFGR'S SERIAL NO.
_____LOCATION	_____MFGR'S STYLE

DATE	PART	REMARKS	COST

If you're careful to enter every maintenance or repair operation on the proper card, it won't be long before each card indicates a particular pattern of maintenance.

Set Up A Maintenance Schedule

Once this pattern is established for all the cards, you can set up a schedule of maintenance points for such items as: packing, greasing or oiling, painting, gasket replacement, and bearing examination. You may find, for example, that a unit or group requires packing maintenance about once every three months, and greasing once every four to six months, etc.

Your next step is to arrange a plant schedule so that a particular pump may be shut down for maintenance at or before these times. Thus you make it possible to do the maintenance work under proper and unhurried conditions to assure maximum conformity of production consistent with long pump life. In addition, examination of the card catalogue will guide operating and maintenance personnel as to quantity of repair parts they should keep on hand.

Make Periodic Inspections Externally

It is considered *inadvisable* to open pumps for inspection.

Rather, recent practice is to let pumps stay on the line until such time as external symptoms indicate overhaul may be required. These symptoms involve either a reduction in effective capacity because of wear at the internal clearance points or mechanical difficulties, such as vibration or noisy operation.

Parts requiring most frequent replacement in centrifugal pumps are: wearing rings, shaft sleeves, packing and bearings.

The most important maintenance point on process pumping equipment is the stuffing box. It must be kept clean, cool, and lubricated—but *packing* is the crucial operation. A good packing method will be discussed in a later edition of *Pointers on Pumps*.

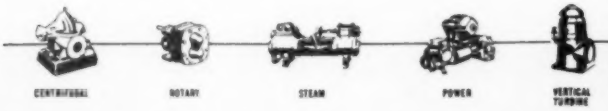
Don't forget the frames, base plates, and supporting parts of your pumps. Good housekeeping often makes it easier to do a good overall maintenance job!

Can We Help You?

Worthington makes more *standard* pumps than any other manufacturer. Don't buy a "special" (at a higher price) without checking to see if Worthington makes it *standard*.

If you *do* need a special, remember Worthington's modern engineering facilities, backed by the longest and broadest experience in the field. Contact our nearest District Office or write to Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.

C.2.2



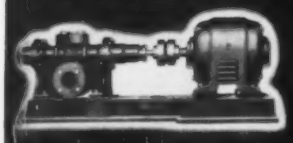
The World's Broadest Line Assures You the Right Pump for Every Job

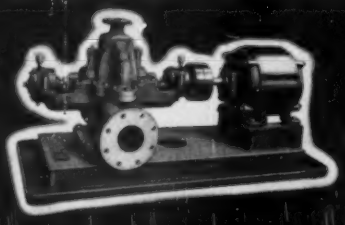
WORTHINGTON

Centrifugal Pumps

It's better
to be right
the first time
If you install a valve that's not precisely suited to the service, it will not last.
But you can be right the first time with Powell Valves because they're designed to meet specific flow control conditions.
There are more specifically adapted Powell Valves in use today than any other make.
The Wm. Powell Co.
Cincinnati 22, Ohio
Fig. 16003 W. E. 600-pound, Cast Steel Pressure Seal Gate Valve with welding ends. A Powell design for the modern Power Plant.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

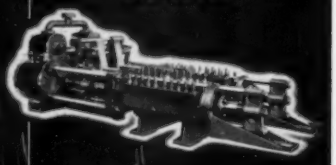
Warren-Quimby Gear-in head Screw Pump





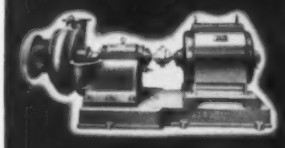
Warren Condensate Pump

Warren Horizontal Duplex Hydraulic Pump



WARREN PUMPS

Maintain efficiency • Operate at low cost • Are long-lived



Warren Type "L" Single-Stage Single-Suction Liquor Pump

CENTRIFUGAL
Single and Multi-stage
Pressure range: Up to 1200 P. S. I.
Capacities: Up to 50,000 G. P. M.
Types: Horizontal and Vertical
Impellers: Open or Enclosed

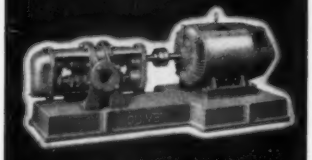
RECIPROCATING
Horizontal and Vertical Single Piston
Horizontal and Vertical Duplex Piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.,

WARREN-QUIMBY SCREW PUMPS
Gear-in-head and External Gear and Bearing
Capacities: Up to 3000 G. P. M.
Pressures: Up to 200 P. S. I. on low viscosity liquids; practically unlimited on high viscosity liquids
Horizontal or Vertical Mounting

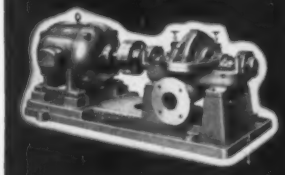
WARREN-QUIMBY ROTARY PUMPS
Gear-in-head and External Gear and Bearing
Capacities: Up to 1000 G. P. M.
Pressures: Up to 250 P. S. I.
Horizontal or Vertical Mounted

Send your pumping problem to us; Warren Engineers will recommend the right pump for the job.

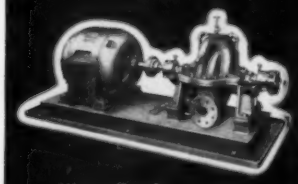
P-28



Warren-Quimby External Gear and Bearing Rotex Pump



Warren Type DBL, Single-Stage Double Suction, Centrifugal Pump



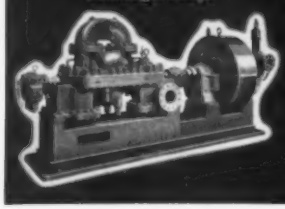
Warren Two-Stage Volute Centrifugal Pump

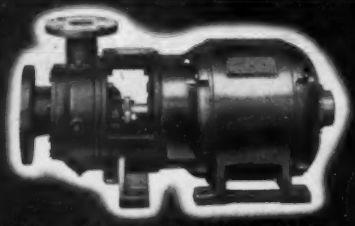
WARREN QUIMBY PUMPS

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

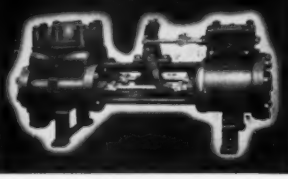
Warren 4- and 6-Stage Centrifugal Pumps





Warren "Compacunit"—4 Types—42 Sizes

Warren Horizontal "Realwear" Duplex Piston Pump



IT'S PACKED
WITH SATISFACTION
WHEN IT'S PACKED
WITH **R/M**

Whatever your packing problem . . . gaskets for a Freon condenser like this one . . . or packings for service against high pressures, high temperatures, chemicals, refrigerants, petroleum, milk or other special fluids . . . Raybestos-Manhattan has a packing or gasket designed for the job. Check your R/M Packing Catalog, or call your nearby R/M distributor.

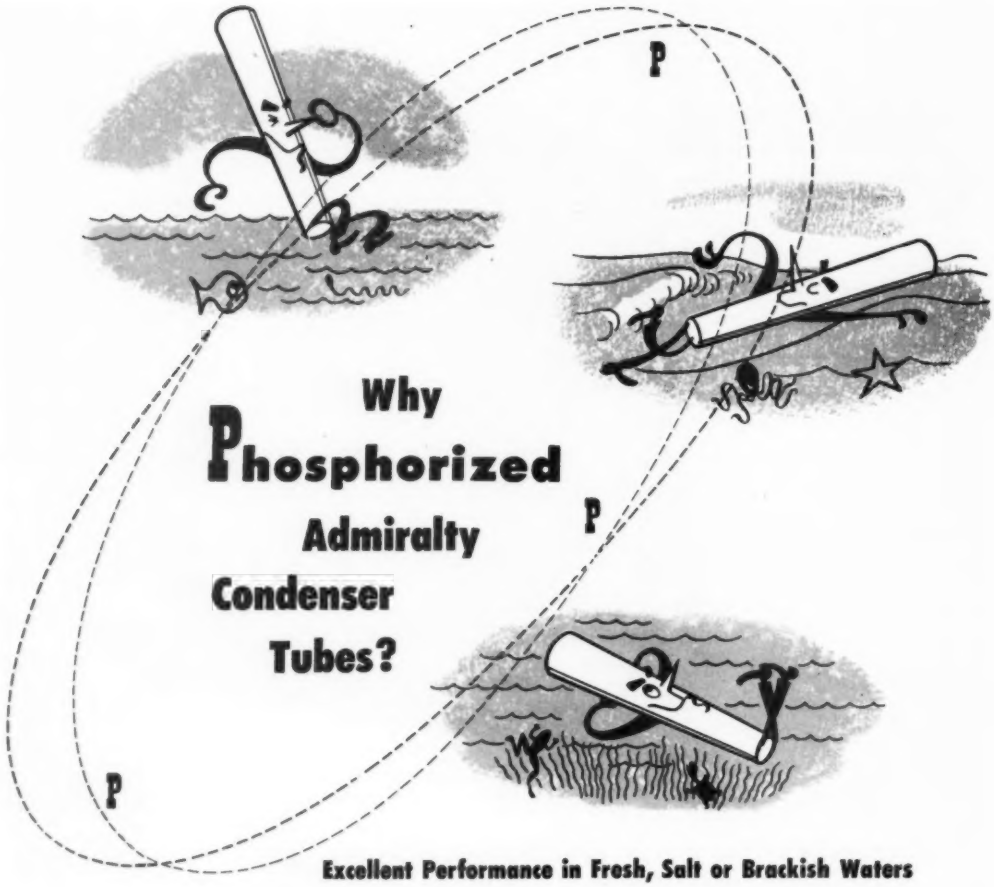
R/M

PACKINGS

RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls



Why Phosphorized Admiralty Condenser Tubes?

Excellent Performance in Fresh, Salt or Brackish Waters

In order to assure *uniform chemical composition* and *inherent soundness*, Scovill produces Phosphorized Admiralty tubes by its continuous billet-casting process which consistently maintains the optimum amount of phosphorus. Adding as little as 0.02% Phosphorus to Admiralty also gives maximum resistance to dezincification while retaining all the other desirable properties of this alloy.

Scovill's 40-page Condenser Tube Booklet is available to users who request it on their business letterhead. Scovill Manufacturing Company, 15 Mill Street, Waterbury 20, Connecticut.

Only Scovill Phosphorized Admiralty Has All These Advantages . . .

- Uniformity and soundness resulting from Scovill continuous-casting techniques
- Relative immunity to dezincification
- Excellent performance in fresh, salt or brackish waters
- High resistance to steam and condensate
- Required heat transfer characteristics
- Superior resistance to general corrosion
- Good resistance to velocities under 7 fps

SCOVILL

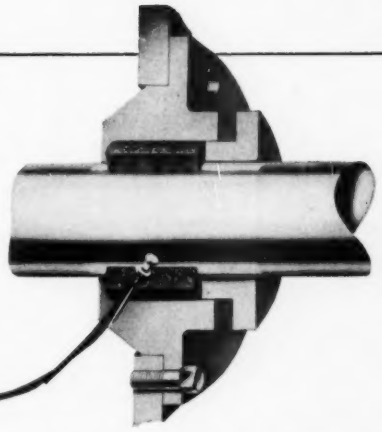
A PRODUCT OF SCOVILL

SCOVILL CONDENSER TUBES

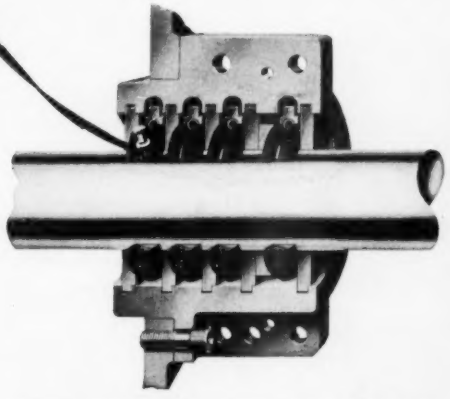
"You can't buy better brass"

COPPUS TURBINES

offer you a choice of packing rings



STANDARD METALLIC RING PACKING — Made of high grade asbestos cores encased in specially treated lubricated aluminum foil. Recommended as a low-friction, long-service packing for steam temperatures up to 850 F and back pressures up to 50 lb. Adjustable packing glands keep leakage at minimum. Easy access to packing rings.



OPTIONAL CARBON RING PACKING — Consists of three carbon packing rings on the pressure side and one beyond the leak-off section. Each ring has three segments held together by a stainless steel garter spring. For back pressures up to 75 lb. Standard for vacuum or gas operation, or when leak-off is desired.

Heavy chrome plating on shaft at stuffing box is common to both types of Coppus packing.

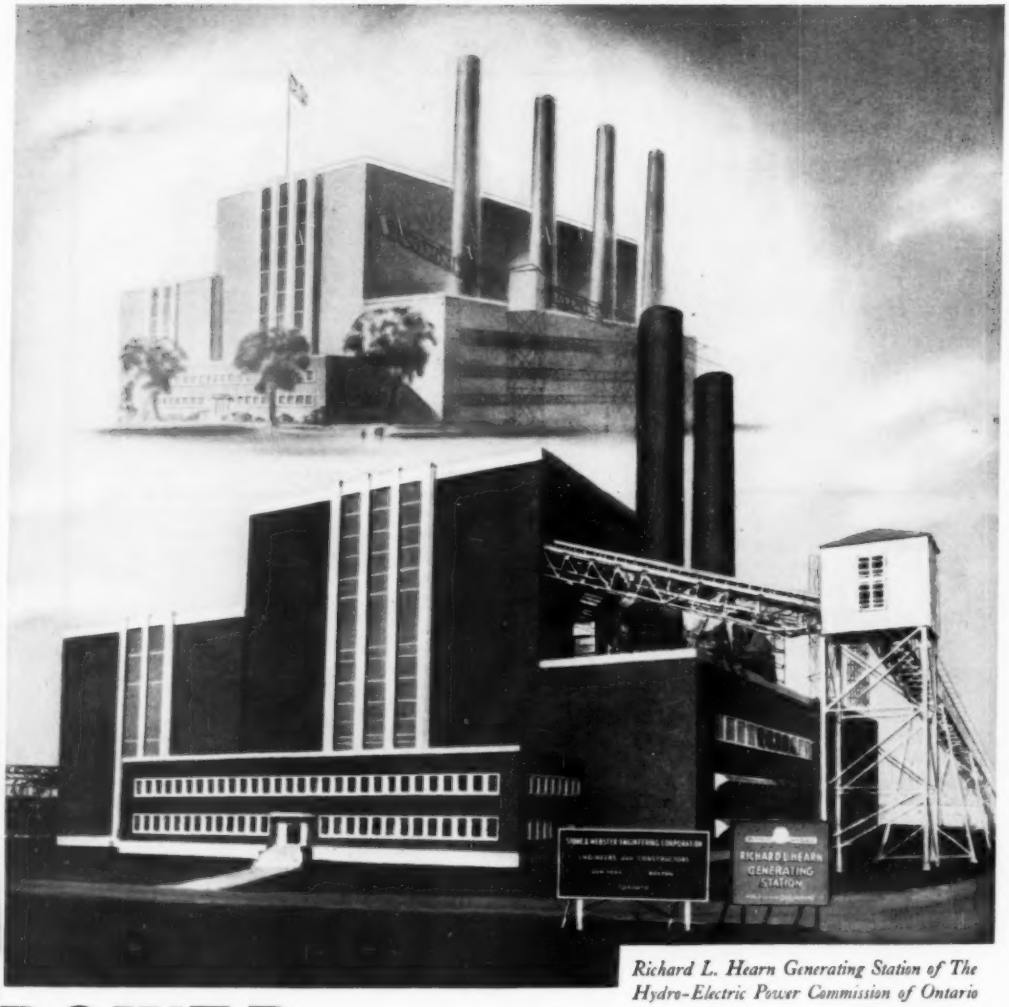
Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

FIT TURBINE COSTS TO HORSEPOWER NEEDS

When you buy turbines rated close to your exact horsepower needs, you save plenty of money. That's because turbines are generally priced in proportion to their size. The wide range of sizes of Coppus Turbines promises purchasing economy for you from the 150 hp size down to the smallest. As for operating and maintenance economies, you get them, too, from such other features as: greater number of manually operated valves for individual control of steam nozzles; replaceable cartridge-type bearing housings and others. For complete details . . .

WRITE FOR BULLETIN 135
COPPUS ENGINEERING CORPORATION
164 Park Avenue
Worcester 2, Mass.
Sales offices in
THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES



Richard L. Hearn Generating Station of The Hydro-Electric Power Commission of Ontario

POWER
FOR ONTARIO AND CANADA'S FUTURE..

Designed and being constructed by Stone & Webster Engineering Corporation, this steam electric generating station on Toronto Harbor will supplement existing hydroelectric generating capacity to meet the demands of the fast-growing Province of Ontario.

Planned for an initial installation of 400,000 kw, it is expected that its ultimate capacity will be 600,000 kw.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

use dependable HAGAN

Ring Balance Flow Meters

to measure flow of

water–gas–steam–oil–air–other fluids

There are many reasons why you get dependable records when you use Hagan Ring Balance Flow Meters.

These include the unique ring torque resistance system which not only makes it possible to meter low flows reliably, but also provides an integral and convenient means for altering the meter capacity to any value over a 3½ to 1 range. Range changing is further simplified by a dead weight method of calibration. Other features include:

- No stuffing boxes
- Adjustable full scale range
- High sensitivity at low flow rates
- Mercury level not critical

Dependable pressure and temperature compensation (either or both) can be furnished with all Hagan Ring Balance Flow Meters.

An economical feature of all Hagan Ring Balance Meters is that maintenance costs are low. For other information on how versatile Hagan Ring Balance Flow Meters will answer your metering problems, clip the coupon, or write.

HAGAN CORPORATION

HAGAN BUILDING

PITTSBURGH 30, PA.

Ring Balance Flow and Pressure Instruments
ThrusTorq Force Measuring Devices
Boiler Combustion Control Systems
Metallurgical Furnace Control Systems

Hagan Corporation
Hagan Building
Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters.

I am particularly interested in.....

.....

NAME.....

POSITION.....

COMPANY.....

STREET AND NUMBER.....

CITY.....ZONE....STATE.....

PE-4

BOWSER ESTABLISHED 1885 has the RIGHT answers for these 2 OIL CONDITIONING PROBLEMS

Portable Bowser Hydro-Volifier conditioning unit for transformers, circuit breakers and switches.

...the best PERFORMANCE INSURANCE money can buy!

INSULATING OIL

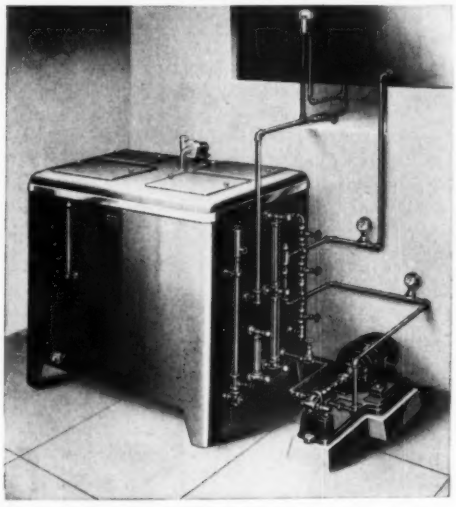
In a SINGLE PASS the Bowser Hydro-Volifier restores oil dielectric to 35 k.v.!
Volatile corrosive acids, gases, dissolved moisture and solids . . . the enemies which promote sludge formation in insulating oil . . . are effectively removed. The process is fully automatic.
NO SERVICE INTERRUPTIONS . . . because this exclusive Bowser process reconditions insulating oils while energized! And less standby equipment is needed.

TURBINE OIL

"Bone dry," crystal-clear oil from a Bowser conditioner is the best stay-on-the-job insurance a turbine bearing can have. Costly bearing failures . . . caused by these 8 destroyers of turbine oil . . . are avoided:

- Turbulence
- Air Entrainment
- Moisture Contact
- Heat
- Metallic Contact
- Inhibitor Removal
- Fly-ash
- Dust

In some plants, turbines served by Bowser units have not had the oil changed for many years.

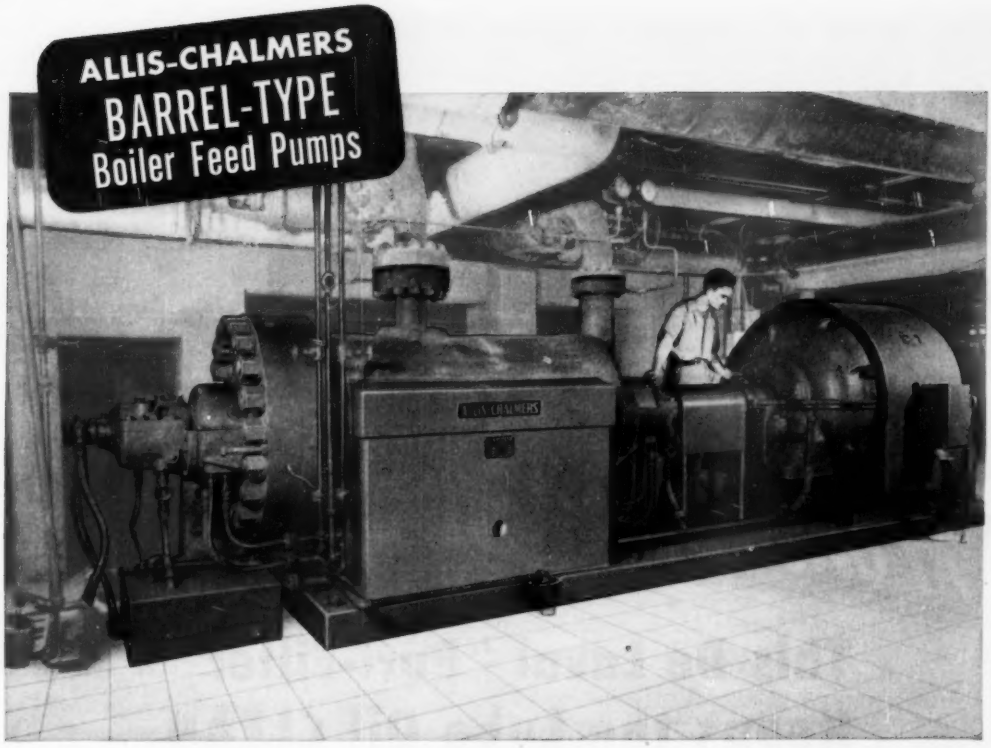


Bowser oil conditioner serving turbine.

Operating costs are much lower with these Bowser units. May we send you complete data?

BOWSER, INC., 1351 CREIGHTON AVENUE, FORT WAYNE 2, INDIANA

Regional Offices • Atlanta • Chicago • Cleveland • Dallas • Kansas City
New York • San Francisco • Washington, D. C. • Hamilton, Ontario



Install New Boiler Feed Pumps at South Carolina Electric and Gas

WHEN 50,000 KW CAPACITY WAS ADDED to Plant Hagood, South Carolina Electric and Gas Company, Charleston, South Carolina, this well know utility chose Allis-Chalmers barrel-type boiler feed pumps. The installations consists of two units like the one shown above. The pump is a 6x6, 11 stage rated at 485,000 lbs/hr or 1055 gpm at a total head of 4100 feet or 1630 psig. Water temperature is 300° F. The motor is an Allis-Chalmers two pole machine rated 1250 hp at 3575 rpm.

Allis-Chalmers barrel-type boiler feed pumps are proving their reliability and low cost of operation in a number of similar installations. Performance records have been such that more than 60 have been ordered for plants now being built.

Engineering Features

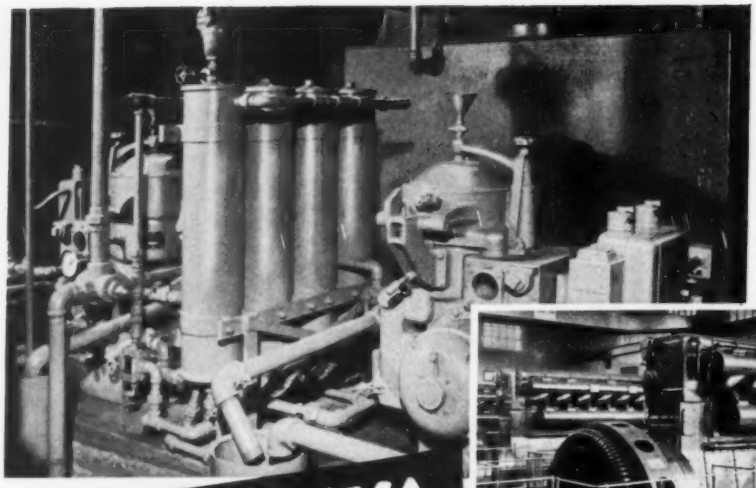
Proved engineering features mean you can depend on good performance and low maintenance. Single-stage back-to-back impellers balance axial forces without the use of a balancing drum. First stage has twin, half-capacity impellers to give the advantages of low NPSH. Expansion joint is on the outside of the pump. No flexible internal members are required to compensate for expansion.

Sizes range from 1200 to 3000 psig and from 300 to 2500 gpm. Allis-Chalmers can supply the complete boiler feed pump package including pump, motor, and control of coordinated design and manufacture.

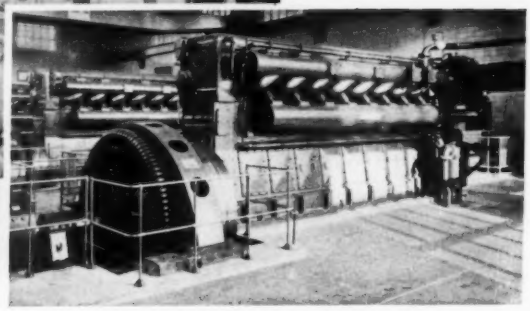
Get the details of this modern-design, performance-proved boiler feed pump from your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3672

ALLIS-CHALMERS



AT OWL'S HEAD—



This De Laval "Puri-Filter" Keeps the Lube Oil CLEAN

To remove all three major contaminants of diesel lubricating oil, Owl's Head uses the De Laval "Puri-Filter." The first two troublemakers — dirt and water — are separated from the oil by centrifugal force. The dirt is stored against the periphery of the bowl where it can not again mix with the oil, and the water is discharged continuously to waste. The third contaminant — colloidal carbon — is filtered out of the purified oil by the filters.

This combination of a De Laval "Uni-Matic" Oil Purifier and a Fram "Filcron" Filter is a completely piped-up unit that is so effective that it gets rid of all solid impurities down to approximately one micron in size. It is by all odds the most effective means ever devised for protecting diesel engine bearings.

Bulletin DL-1 gives additional details. Write for your copy.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL for most dependable power production

LUBRICATING OIL PURIFIERS

"S" MONEL

A casting alloy offering extra hardness at elevated temperatures, pronounced resistance to galling and seizing, and excellent corrosion resistance.

One of the hardest and strongest of the non-ferrous casting alloys, "S"® Monel is particularly suitable for parts subject to high stress and severe friction under corrosive conditions.

"S" Monel's low coefficient of expansion, high density and corrosion resistance enable it to give excellent service where clearances are small and operating temperatures subject to considerable variation.

The principal characteristics of "S" Monel are:

• • •

Typical Applications of "S" Monel

valve discs	bushings
valve seats	sleeves
impellers	ejector nozzles
wear rings	direct-acting pump liners

Mechanical Properties of "S" Monel*

(Age-hardened)

Yield Point	80-115,000 psi
Tensile Strength	120-145,000 psi
Elongation in 2-in.	4-1%
Hardness (Brinell)	300-375
Coefficient of Thermal Expansion (32°-212°F.) in./in./°F.	.0000068

Hardness of "S" Monel at Elevated Temperatures*

(As-cast condition)

Temperature, °F.	Brinell Hardness
Room	321
700	321
800	311
900	311
1000	321
1050	335
1100	293

*Average properties—not to be used for specification.

Hardness: "S" Monel can be age-hardened to 300-375 Brinell. It retains this hardness even at elevated temperatures. (See table.)

Resistance to Galling: "S" Monel is superior to most other hard metals in its ability to resist galling under severe conditions of pressure and friction. Often where lubrication is poor or absent entirely, "S" Monel has shown unusual resistance to seizing.

Corrosion Resistance: "S" Monel is relatively unaffected by most commonly-encountered corrosives . . . reducing acids, organic acids, acid and neutral salt solutions, strong alkalies, dry gases, and most atmospheres.

Erosion Resistance: Because of high hardness and toughness, "S" Monel resists damage caused by cavitation, erosion, "wire drawing," and particle abrasion.

Weldability: "S" Monel is *not* recommended as a weldable material.

Machinability: "S" Monel can be machined as-cast, and preferably so when only a moderate amount of machining is to be done. For extensive machining, the castings may be softened to 235 Brinell by heat treatment. Subsequent heat treatments can restore hardness to the level of 300-375 Brinell.

Right now, "S" Monel, like other Inco Nickel Alloys, is on extended delivery because so much is needed for defense. Therefore, it will pay you to anticipate your needs and order well in advance. Be sure to include NPA rating and end-use information. And remember, if you have a particular metal problem, you can always call on Inco's Technical Service Section for help. Just write outlining in detail. For additional information on "S" Monel, write today for your copy of "Inco Standard Alloys for Special Problems."

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

NICKEL (INCO) ALLOYS

MONEL® • "R"®MONEL • "K"®MONEL • "KR"®MONEL • "S"®MONEL
NICKEL • LOW CARBON NICKEL • DURANICKEL®
INCONEL® • INCONEL "X"® • INCOLOY® • NIMONICS

1. water level only
   or
2. water level *plus* steam flow
   or
3. water level *plus* steam flow *plus* feed water flow

No matter how many control influences you prefer on your Boiler Feed Water Regulators . . .

COPES will give you correct feed and close level control—without depending on any other instruments.

NORTHERN EQUIPMENT DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
422 GROVE DRIVE, ERIE, PENNA.

COPES

BOILER FEED WATER REGULATION

USKORONA

is specified by leading utilities because

only USKORONA is resistant to both moisture and ozone

ENGINEERS of United States Rubber Company developed Uskorona because they believe a tape should be resistant to moisture as well as ozone.

That is why electrical engineers insist on Uskorona in the design, installation, operation and maintenance of power lines where corona (ozone) or moisture is a problem. Uskorona provides ideal insulation in splicing or joining electrical cables on underground power lines, on secondary network systems, underground street lighting circuits, and transformer leads.

Remember, only Uskorona gives you the two-fold protection against moisture and ozone. Write to address below.

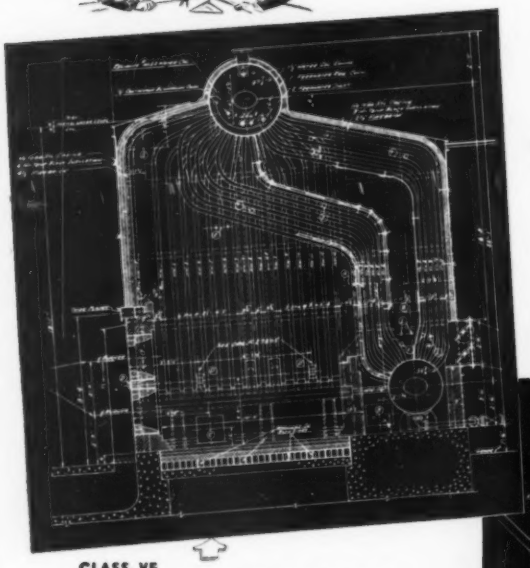
USKORONA SPLICING COMPOUND
US
30 FT. ROLL
¾ IN. WIDE
OZONE AND MOISTURE RESISTING COMPOUND
Uskorona combines maximum resistance to OZONE and MOISTURE with high tensile strength, elongation and dielectric resistance. Fuses quickly without heat or pressure and makes PERFECT SPLICES
MADE IN U.S.A.
United States Rubber Company
LET US SEND YOU A SAMPLE
U.S.RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

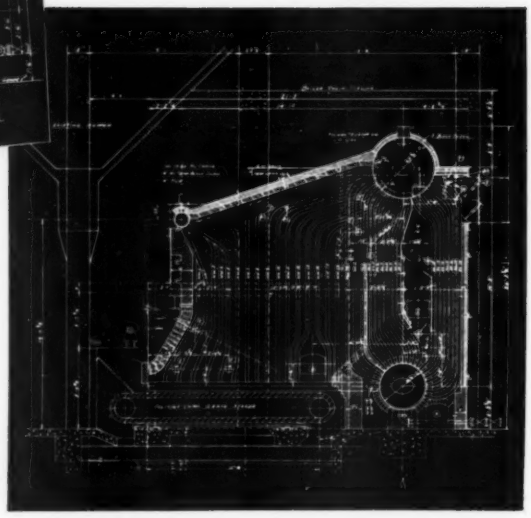
TAPE DEPARTMENT • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Industry Approved

Two-Drum
STEAM GENERATORS
by Vogt



CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
The Seelbach Hotel, Louisville, Ky. is served by this 30,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

A bulletin with general information and showing typical installations is available on request.

Typical Users...

FOOD PROCESSING PLANTS

DISTILLERIES • HOTELS

HOSPITALS • CHEMICAL PLANTS

PETROLEUM REFINERIES

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

STOP CORROSION

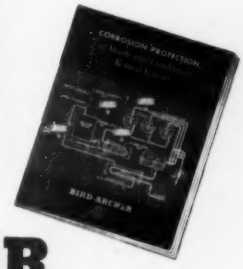
with BIRD-ARCHER AMINE TREATMENT

Unretouched photograph shows the ravages of corrosion on condensate return lines.

Corrosion of piping in steam and condensate return lines is an expensive two-way headache. (1) It leads to large outlays for pipe replacement and maintenance. (2) It often results in plugged return lines and traps due to the solid products of corrosion. Bird-Archer Amine Treatment effectively eliminates these troubles at low cost.

Here's how. Amines are fed into the boiler or into the steam and condensate systems. The amines raise the pH value of the condensate and also tend to inhibit equipment-destroying corrosion through surface protection of the metal itself. In scores of plants, this Bird-Archer system has more than paid for itself by substantially cutting replacement and maintenance costs.

Bulletin CP 100
gives all the facts on Bird-Archer Amine Treatment. Write for your copy.



LABORATORIES ENGINEERS · CHEMISTS

BIRD-ARCHER
WATER TREATMENT

THE BIRD-ARCHER COMPANY, 4337 NORTH AMERICAN ST., PHILADELPHIA 40, PA.
NEW YORK • CHICAGO

IN CANADA: The Bird-Archer Co., Limited, Cobourg, Ontario
In Mexico: Calderas y Accesorios, S.A., Amsterdam 291, Mexico, D.F

BA 166

How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

Correct installation cures many packing troubles

Make sure I'm the right size

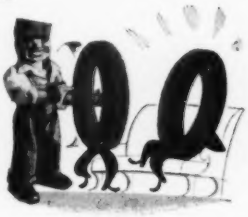
Packing that's too small may turn with the shaft. Oversize packing may cause excessive pressure and subsequent scoring. To find the correct size, check the rod or shaft diameter and the inside diameter of the stuffing box—then choose a packing to fit. In this way, allowance is automatically made for wear of the rod.

Danger! Don't mix me with old packings

Old packings may look all right, but often they are so dry and highly compressed that they may cause scoring. Play it safe and remove *all* old packing before putting new packing in place. Be sure to remove accumulations from stuffing box walls, gland follower and shaft. New packing is cheaper than new rods, shafts and sleeves!

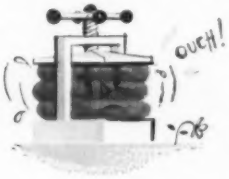
Seat me one ring at a time

Never load the stuffing box with packing rings and try to seat them all at once by tightening the gland follower. This invites trouble due to excessive gland pressure. Always install one ring at a time, making sure it's properly seated *before* the next ring is installed.



Don't squeeze me too tight!

Too much gland pressure is a common cause of packing failures. After the packing is installed, pull up the follower only sufficiently tight to insure seating of the last rings installed. Then back it off, leaving the nuts finger-tight. Don't worry about a little leakage. Actually, it's good assurance that the packing isn't too tight in the stuffing box. Besides, the liquid frequently has some lubricating qualities.



Why you can expect longer life from

NAVALON Style No. 190

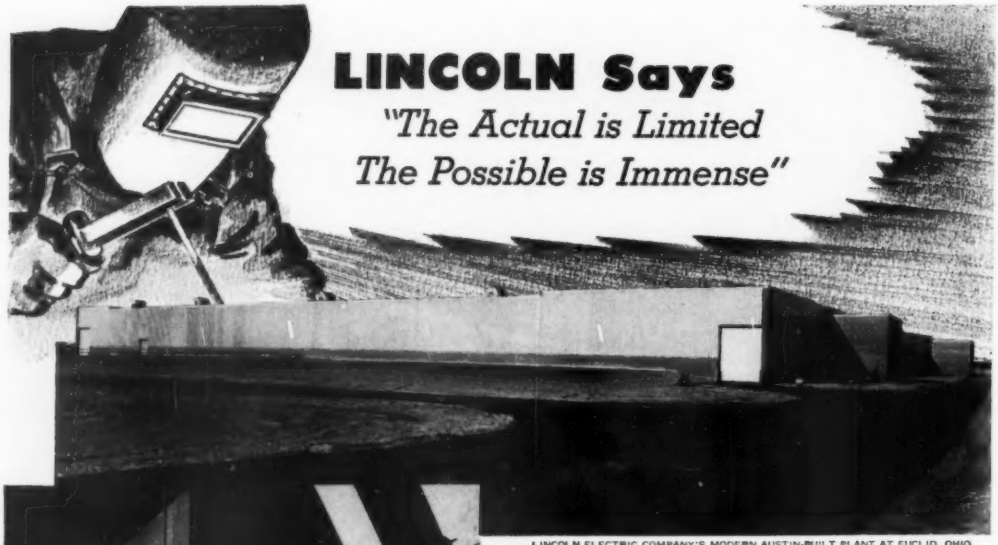
Made from specially processed ramie—nature's strongest fiber—Navalon stands up in severe service where other cold-liquid packings fail. It gives outstanding performance in pumps, elevators, accumulators, presses, and on reciprocating rods and plungers operating against fresh or salt water, brine, cold oil and many other liquids.

Your distributor will help, too! Your J-M Packing Distributor can help you take the guesswork out of packing problems. He carries complete stocks of Johns-Manville quality packings and can supply you promptly. For the address of the J-M Packing Distributor nearest you, write Johns-Manville, Box 290, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

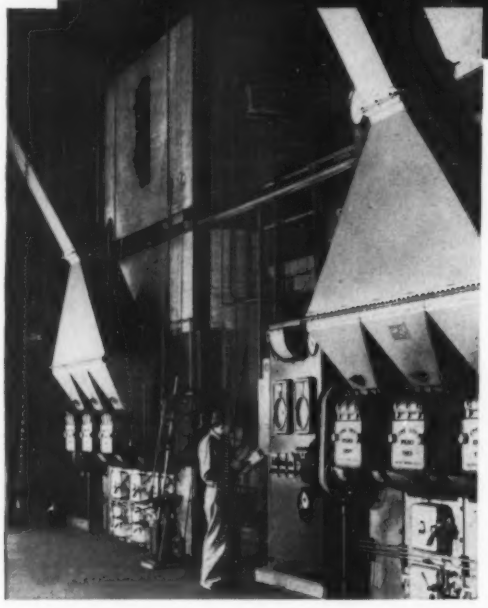
SUTHERLAND
PAPER COMPANY
installs 12th WICKES
STEAM GENERATOR
The new WICKES boiler in SUTHERLAND'S Michigan plant produces 120,000 lbs. steam per hour at 475 lbs. pressure and final steam temperature of 850° F.
Like so many industries and institutions that require steam, the SUTHERLAND PAPER COMPANY with plants in Kalamazoo, Michigan, and Santa Clara, California, has learned to depend on WICKES for efficient steam production. That's why they've just installed their twelfth WICKES boiler in 38 years of successful paperboard manufacture. The new WICKES boiler at the SUTHERLAND PAPER COMPANY is fired by spreader stoker but these units are readily adaptable to any standard method of firing. It is equipped with a superheater and an economizer and the design makes it especially practical where space is limited. WICKES can fill your needs for steam generators up to 250,000 lbs. per hour and 1000 psi. Write today for descriptive literature or consult your nearest WICKES representative.
WICKES
THE WICKES BOILER CO., SAGINAW, MICHIGAN • A DIVISION OF THE WICKES CORPORATION
SUCCESSORS QUALITY SINCE 1884 • SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C.



LINCOLN Says

"The Actual is Limited
The Possible is Immense"

LINCOLN ELECTRIC COMPANY'S MODERN AUSTIN-BUILT PLANT AT EUCLID, OHIO



BOILER and STOKER DATA

BOILERS	2-ERIE CITY 2-DRUM (550 hp.)
CAPACITY	38,000 pounds STEAM per hour
DESIGN PRESSURE	160 lbs.
FIRING EQUIPMENT	2-ERIE CITY DUMPING GRATE SPREADER STOKERS
FUEL	OHIO BITUMINOUS

We Agree - Here's Why

Erie City Iron Works is proud to have Erie City Boilers and Stokers installed in Lincoln Electric Company's modern Austin-built plant at Euclid, Ohio.

As the oldest boiler builder in America, we well remember when the "Actual" in the Lincoln motto seemed to us to be "limited" by the skill of the riveter. Today, thanks to the great advance in welding science, we find "Possibilities Immense." Today, Lincoln welded seams are routine in all Erie City Boilers, and former potential trouble points are transformed into the strongest parts of the boiler shell.

There's a modern Erie City Boiler to meet any steam demand. Outline your requirements.

ERIE CITY
112 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

engineering...

While we could not hope to duplicate this Springtime magic which Orioles take for granted, Pipe and Tubular Products is, nevertheless, a firm of engineers. Specialists in our own craft of pipe and tube fabrication, our new, larger plant at Catasauqua, Pa., enables our engineers to produce more goods in less time . . . to serve your needs with maximum speed, and at minimum cost.

Pipe and Tubular Products has a wealth of experience in producing bent tubing elements for boilers, condensers and superheaters of carbon, alloy and stainless steels as well as welded tubing and structural fabrication. Recent additions to our plant now add a complete machining department as well . . . and open up channels for increased service to our customers, both new and old.

Service has always been a specialty with us, and we are particularly adapted to supplying tubes for emergency repair work, usually shipping orders the same day on which they are received.

And, like the Orioles above, we, too, often fly our shipments direct to the site.

PIPE & TUBULAR PRODUCTS
INCORPORATED
Tubing P&P *Specialists*

OFFICE: 8504 GERMANTOWN AVENUE, PHILADELPHIA 18, PA.
PLANT: CATASAUQUA, PENNSYLVANIA

tubing and piping • warehousing and fabricating • engineering and machining

here's a complete WATER WORKS in a small package...

JBAS

for:

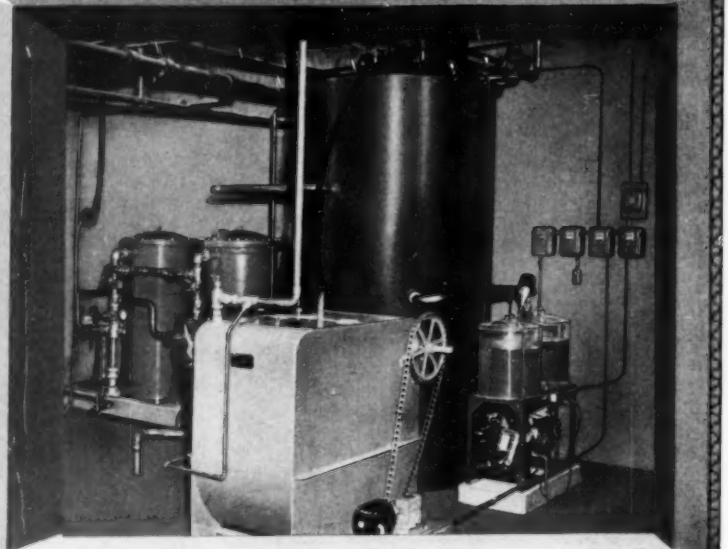
FIELD CREW DRINKING SUPPLY

ENGINE COOLING

BOILER FEED

SMALL DOMESTIC SUPPLIES

CHEMICAL AND MANUFACTURING PROCESS



FOR THE MANY USES OF TREATED WATER, INFILCO ENGINEERS THE JBAS ACCELATOR

The JBAS doesn't care if your source of water is creek, river, lake or well. It is equally effective for softening, clarifying, sterilizing, or removing organic matter, tastes, or odors. Its versatility has been demonstrated in hundreds of installations treating 5 to 100 gallons per minute, providing a water equal or superior to large municipal supplies.

Ask for Bulletin 1845

and see how a JBAS conserves space and installation costs. Learn how and why JBAS gives uniformly satisfactory results with minimum supervision and attention. Note it can be readily moved, too, if necessary.

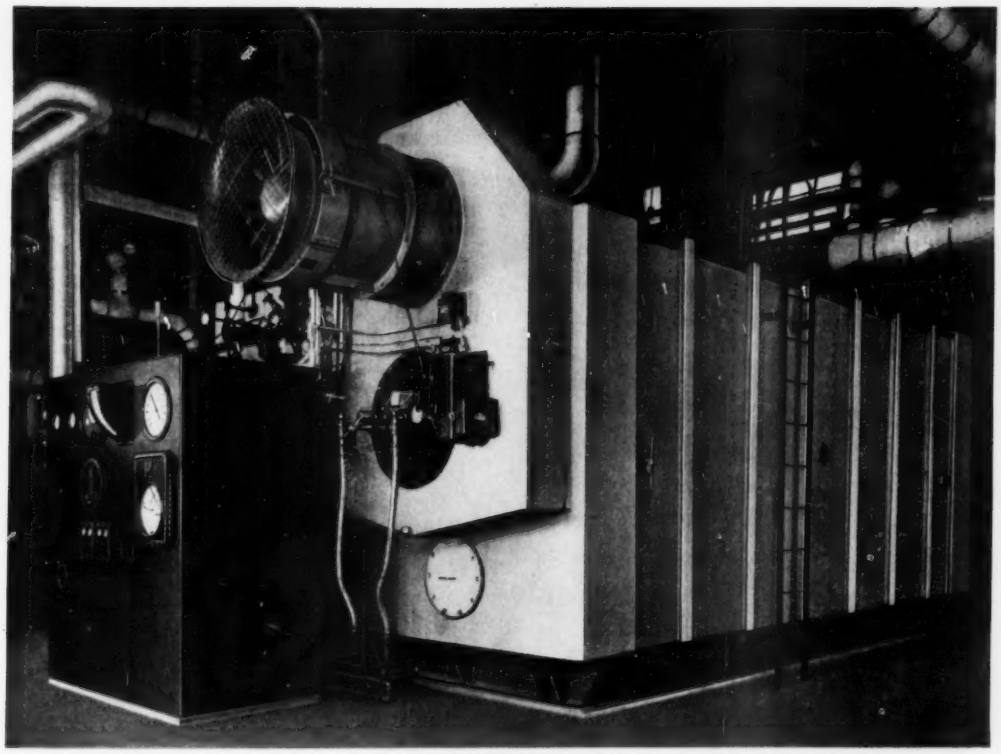
INFILCO

* BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1914 *

INFILCO INC. *Tucson, Arizona* | *Plants in Chicago & Joliet, Illinois*

FIELD ENGINEERING OFFICES IN 26 PRINCIPAL CITIES

World's Leading Manufacturers of Water Conditioning and Waste Treating Equipment



making FRIENDS fast

The B&W Integral-Furnace Boiler, Type FM

SHOP ASSEMBLED FOR SAVINGS

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

All the benefits of "packaged" steam are combined with the traditional economies and big boiler advantages of B&W's Integral-Furnace design in this compact, shop-assembled, ready-to-use unit. You can set it down wherever you want it, and set it up —ready to operate—in jig-time.

Already, well over 100 users in 24 broad industrial and commercial classifications in 29 states, two territories and 6 foreign countries have selected the B&W Integral-Furnace Boiler, Type FM, to produce a total 4,200,000 lb per hour of low-cost steam. Many of these users have placed repeat orders.

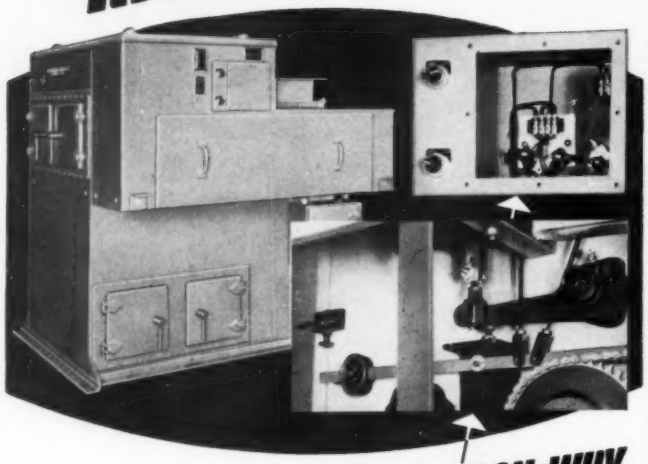
This popular self-contained unit is available for efficient heating and process steam-generation from 2900 to 28,000 lb per hr. at pressures to 250 psi. It's worth investigating.

Send for bulletin G-76 detailing advantages of this latest B&W creation in low-cost steam generation. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

G-560

YOU CAN'T BUY A BETTER COAL SCALE THAN A RICHARDSON



..AND HERE'S ANOTHER REASON WHY..

WIRING AND CONTROLS OUTSIDE COAL CHAMBER

All electrical wiring and controls are outside the coal chamber. The sulphuric-acid-laden air and dust of the coal chamber can never harm a Richardson Coal Scale because of this fact. In all ways—in all aspects of design and construction—sound, foresighted, time-proved Richardson engineering is your assurance that the dependability, accuracy, and ruggedness built into the Richardson Scale will be maintained for the life of the unit. Richardson inspection and service are available nationwide.

RICHARDSON SCALE COMPANY
Clifton, New Jersey

Atlanta • Boston • Buffalo
Chicago • Cincinnati • Detroit
Houston • Minneapolis • New York
Omaha • Philadelphia • Pittsburgh
San Francisco • St. Louis • Wichita
Montreal • Toronto

Write for bulletins, and remember . .

YOU SPECIFY QUALITY WHEN YOU SPECIFY

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

8370

ENGINEERS' PREVIEW

(*Continued from page 8*)

cents per thousand gallons of pure water. Industrial supplies from fresh water sources now run as high as 10 cents per thousand gallons, so the new process is not too far from commercial economics, it is claimed to make it worth further investigation.

★ ★ ★

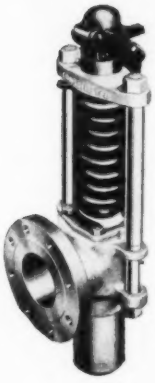
TO HELP alleviate, from a long range point of view, the critical shortage of engineers now existing, a new educational experiment got under way at Schenectady recently when an educational conference was held between some 400 high school students, their counselors, and a group of selected GE engineers. Representing joint efforts of professional engineers, high school guidance personnel and industries in the area, the conference was said to be the first of its kind. It was aimed primarily at exposing high school students to engineering and its possibilities as a vocation, not through booklets and pamphlets but through direct informal meetings conducted on a local scale. Indication of its success was that the students sat through the first 3-hour conference without a break and fired literally hundreds of questions at the practicing engineers present.

★ ★ ★

AT A MEETING of the Prime Movers Committee of the Edison Electric Institute in November 1951, opinions and reasons were advanced for going to even larger units of equipment in the steam plant than are now used. A panel of top utility engineers discussed the subject and one of them reported on studies, supported by actual cost experience, which indicated that a plant of two-boiler, two-turbine arrangement would cost 25 per cent more than a one-boiler, one-turbine arrangement. If one-boiler one-turbine could replace an eight-boiler eight-turbine plant, total construction cost could be halved. It was pointed out that the use of large units, up to 300,000 kw and perhaps beyond that, was easily supported percentage-wise by electrical load growth and interconnection of electrical generating facilities.

★ ★ ★

CAPACITY of the Commonwealth Edison system in the Chicago area reached 3,062,000 kw in January, when a new 110,000-kw unit was placed in service at the Waukegan generating station of Public Service Company of Northern Illinois, which serves the system's territory outside the City of Chicago. The new Wau-



Safety valves with greater discharge capacity and shorter blowdown are essential on high-pressure, high-temperature steam generating equipment. Consolidated *Maxiflow* Safety Valves release the greatest amount of steam that can flow through a given size inlet with imposed entrance conditions.

They provide other functional advantages. Tightness is permanent: thermodisc seating eliminates distortion due to thermal stresses—temperature differentials are quickly equalized. The forged steel through bushing has precision-machined surfaces for better steam flow, greater resistance to erosion, corrosion. Blowdown can be controlled with the externally adjustable "micrometer" trim ring while the valve is under pressure. By combining proper compensation with metals of low coefficients of expansion, the popping point is retained.

Get complete safety and service feature data; also capacity tables. Write for Consolidated *Maxiflow* Safety Valve Bulletin 707.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.
MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

..with the type ASR Synchronizing Relay

Getting the motor started right every time—and providing complete protection at all times—are the basic functions of the new Westinghouse SLIPSYN Synchronous Motor Control.

Heart of the new SLIPSYN is the amazing Type ASR synchronizing relay. Characterized by its extremely simple, sturdy and reliable design, this new relay is especially suited for heavy industrial service.

The ASR not only applies the field at the proper speed, but also at a favorable rotor position for best synchronizing performance. It is easily adjusted on the job for best operating conditions under actual load.

**Trade Mark*

SLIPSYN is the name applied to the complete line of Westinghouse Synchronous Motor Control. Standard types are available for operating and protecting all types of synchronous motor drives. Find out all the advantages of SLIPSYN controls now. Call your nearest Westinghouse office or write for Booklet B-4379. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-21588

Westinghouse
SLIPSYN
SYNCHRONOUS MOTOR CONTROL

kegan unit is the sixth added to the system since the end of World War II. Five additional units are in various stages of construction. These five, with a capacity of 660,000 kw, will bring total system capacity to 3,722,000 kw by the end of 1954.

The five units now under way include two of 150,000 kw each at Edison's Ridgeland Station, one of 60,000 kw at Public Service's Dixon station, and two of 150,000 kw each to be installed at the new Will County Station of Public Service on the Illinois waterway between Lockport and Lemont. Construction of the latter will get under way later this year.

★ ★ ★

VALUE of standardization to electric utilities and electrical equipment manufacturers is emphasized in the first comprehensive survey made of savings effected in American industry by the use of standards. This 32-page survey, entitled Dollar Savings Through Standards, has been released by the American Standards Association and copies can be obtained from the Association at 70 East 45th Street, New York 17, N. Y.

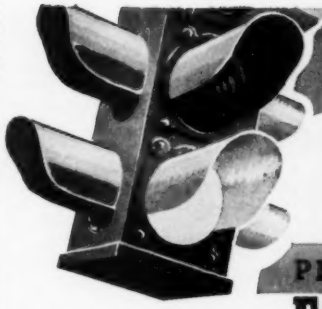
★ ★ ★

FEDERAL POWER COMMISSION has rejected the application of a natural gas distributor to sell gas to the TVA for a fuel under the boilers of an electric generating plant at Johnsonville, Tenn.

The Commission pointed out that TVA is close to vast deposits of bituminous coal; that coal has always been available for its steam-electric generating plants; and that coal producers have offered to supply far larger tonnages than TVA can use. Hence, the Commission declared, there is no reason to doubt the abundant availability of coal in the future.

★ ★ ★

BREATHES there the engineer with soul so dead that he has never had to take any interest in the air pollution abatement program? We've never met one yet. Now a most ambitious project is being undertaken by the Manufacturing Chemists' Association to produce an air pollution abatement manual. This is an 8½ by 11 loose leaf publication divided into separate chapters, which are being issued at intervals and can be all bound together. Chapters already published are the following: Chapter I — General Introduction of the Subject; Chapter III — Discussion of Community Relations and how the engineer should handle them; Chapter V — Physiological Effects, to show, for example, the effects of dirt, offensive odors, eye and nose irritations

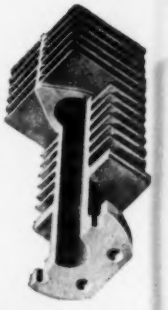


GREEN

PREMIER DIAMOND

ECONOMIZERS

Good Parts are Essential to a Good Machine . . . Let's examine a Green Fuel Economizer—Type 25—and study the major parts.



FINNED CAST ALLOY IRON TUBES WITH DIAMOND SHAPED SECTION

The diamond shape provides less restricted gas flow; easy cleaning and clearview inspection. The fins provide maximum heating surface in given space.

SEPARATE SUPPORTING AND JOINTING FLANGES

Supporting flange is separate from and independent of jointing flange. Jointing flange is not exposed to hot gases. Through bolts rather than studs are used to connect jointing flanges.

CORRECTLY PROPORTIONED, STRONG CONNECTION BENDS

These are designed to provide needed flexibility with strength. Flanges on tubes, bends and manifolds are accurately machined.

Green specially designed Soot Blower assures thorough cleaning.

Green Type 12 Premier Diamond Economizers—the Steel Tube Units—are made up of equally strong and well designed parts. Send for Bulletin No. 169.

THE GREEN Fuel Economizer COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

DART

...the Union that is its own Best "Replacement"!

(YOU CAN USE ONE OVER AND OVER AGAIN)

Yes, you can take a Dart off one installation and put it on another. Or put it back on the same installation—time after time. That's economy!

Here's why you can get so much work out of a Dart:

- ***Drop-Tight Yet "Easy Does It"***
  Dart's spherically ground seats provide a wide, full bearing surface that requires a minimum of nut take up. Excessive wrenching (hard on metal and man) isn't required. What's more, a Dart *stays* tight.
- ***Non-Corrosive Bronze Seats***
  Why do they use bronze for memorial plaques? Because it *lasts!* That's why *we* use this non-corrosive metal for protection of seats against pitting and corrosion.
- ***Practically Indestructible Nut and Ends***
  Air refined malleable iron is tops for resistance to stress, stretching and wrenching. That's why we use it for Dart nuts and ends.

Test a Dart on your next job. You'll *like* its quicker, easier action — you'll *save* by its longer working life!

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston New York Pittsburgh

DART
UNIONS

on human beings and many of their effects on animals and vegetation and a table of maximum allowable concentrations of all sorts of chemical substances that may be found after discharge into the air; Chapter VII — Discusses in detail the analytical methods for determining various substances in the air; Chapter IX gives details of mist and dust collection, describing all the principal types of equipment that can be used for this purpose. The remaining seven chapters, to be published at intervals during 1952, will consist of the following: Chapter II — Terminology and Selected Data; Chapter IV — Legislative Requirements; Chapter VI — Sampling Procedures & Measuring Equipment; Chapter VIII — Meteorology of Air Pollution; Chapter X — Gas and Vapor Abatement; Chapter XI — Evaluation of Data; Chapter XII — Bibliography.

Full information about this manual may be obtained from M. F. Crass, Jr., Secretary, Manufacturing Chemists' Association, Inc., 246 Woodward Building, Washington 5, D. C.

★ ★ ★

THE STATUS of engineering education, as we have often pointed out, has the most vital bearing on the future of the engineering profession. Objectives now universally accepted in university teaching, and, in particular, engineering teaching, are: first, teaching the student to think; second, teaching him fundamentals. However, there is a third objective that might seem more or less self-evident because it is in effect the end product of the entire teaching process. Nevertheless, W. L. Everett, Dean of the College of Engineering of the University of Illinois, proposes and discusses this third objective, which is teaching to achieve action. In an article, Education for Action, in the December 1951 *Journal of Engineering Education,* he submits these premises: 1 — The basic aim of the professional man is to achieve sound action. 2 — The basic job of the teacher of professional men is to prepare his students to do this. Dr. Everett then discusses the details and methods by which the engineering instructor can and should achieve the three objectives. Every engineer ought to read this article. He can use it.

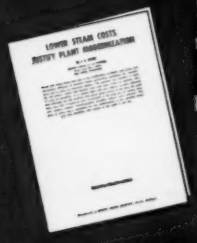
★ ★ ★

IN CASE you haven't already heard of it, better get used to the idea that Flexonics Corporation is the new name of Chicago Metal Hose Corporation, effective January 2, 1952, and announced on the occasion of the company's Golden Anniversary.

★ ★ ★

DETROIT ROTOGRATE STOKERS *Plus* MODERNIZED BOILERS

PAY BIG DIVIDENDS



DETROIT STOKER COMPANY

General Motors Building • Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Mich.

DETROIT *SINCE 1898* STOKERS

BIDDLE *Instrument News*

IF YOU MEASURE *SPEED*
YOUR BEST BET IS *BIDDLE*

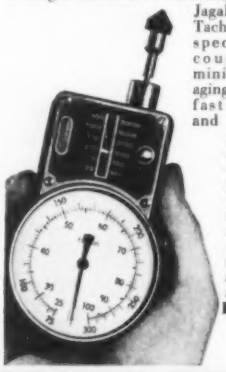
***If you want*—Readings of**
AVERAGE RPM or FPM...

—choose one of the several ranges available in **Jagabi® Chronometric Speed Indicators** from 0-100 up to 0-100,000 rpm. The shaft or spindle is set in ball bearings. No lubrication needed. Design and construction of these instrumentsis such that a minimum of maintenance is required even in constant, severe service.

The **Jagabi Tachoscope,** stop watch and revolution counter, is also recommended for high accuracy work. **BULLETIN 35-PE.**

***If you want*—Readings of**
INSTANTANEOUS SPEEDS or VARIATIONS in SPEEDS

. . . select the **Jagabi® Centrifugal Tachometer**—speed ranges 25 to 48,000 rpm. Three—and five—ranges in one instrument . . . or the **Dr. Horn Tachometers** which are made with 6 ranges between 25 and 30,000 rpm. Both Jagabi and Dr. Horn Tachometers have a special friction coupling which minimizes the damaging effects of too fast acceleration and over-speeding. Results: Low maintenance and long, dependable service life, for direct indicating, rpmshaftorfpm linear and peripheral speeds and speed variations. **BULLETIN 35-PE.**



B-812

If you want*— QUICK and ACCURATE RPM READINGS with *SAFETY

. . . Consider the advantages of **Frahm® Resonant Reed Tachometers** for hand use or permanent mounting.

No contact with moving parts is required. Just touch the instrument to the chassis, frame or housing of the machine or motor and read the rpm directly. No moving parts. No lubrication or maintenance required. Accurate to ½ of 1%, they will operate continuously for years without any appreciable change. Instruments with limited ranges available for as little as $27. Practically any desired range within 900 and 100,000 rpm can be supplied. **BULLETIN 41-PE.**

JAMES G. BIDDLE CO.

ELECTRICAL TESTING INSTRUMENTS
•
SPEED MEASURING INSTRUMENTS
•
LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET, PHILADELPHIA 7, PA.

James G. Biddle Co.
1316 Arch St., Phila. 7, Pa.

Gentlemen:
Please send me material checked:

☐ 35-PE ☐ 41-PE

NAME

JOB FUNCTION

COMPANY

ADDRESS

New ENGINEERING BOOKS

Refresher Notes in Hydraulics, Thermodynamics, Machine Design, for Professional Engineers' License Examination; Third Edition; by John D. Constance; 300 pages; illustrated; size 8½ by 11 in.; paper binding; published by the author, John D. Constance, 625 Hudson Terrace, Cliffside Park, N. J.; price $4.50 postpaid.

This is one of the most practical discussions of various phases of engineering, as covered by the Professional Engineers License Examination, that has yet appeared. The author has attempted here to provide a convenient and time-saving instrument for graduate engineers who are preparing for the licensing examination to practice professional engineering. The primary purpose of the notes, therefore, is to make available for ready and rapid use a refresher on the fundamental concepts, methods and practical applications of the basic engineering sciences, including hydraulics, thermodynamics and machine design. This material was originally presented by the author in a 20-lecture refresher course, sponsored by the Metropolitan Section of the ASME in New York City.

In preparing for an examination, a certain technique must be used so that the candidate will feel at home in the examination room. These notes attempt to do this by screening out the superfluous material and exposing the reader only to a comprehensive collection of selected sample problems, compiled from past examinations, together with their solution.

The book discusses first the principles of hydrostatics and hydrodynamics, then shows the methods of calculation used for circular orifices.

Following this is a treatment of flow through pipes running full, including such calculations as losses at entrance and contractions, resistance of fittings to flow, mechanism of fluid flow, Reynolds Number, and so on. Following this is discussion of flow in open channels and then calculations for centrifugal pumps.

The next section takes up thermodynamics and heat, behavior of gases and vapors, compression and expansion of air, flow of gases and vapors through orifices and nozzles.

Under machine design are discussed the fundamental principles, followed by springs, belt transmission, tooth gearings, lubrication, bearings, machines, flywheels and forces on crankshaft.

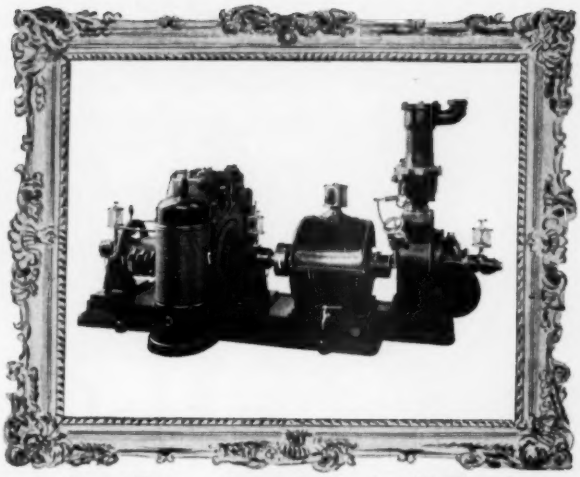
In all cases, the practical aspects of the problem are reviewed, the necessary practical formulas are given and many examination problems are shown with their solutions all worked out mathematically.

For those engineers who must "bone up" for the license examination, this book should be of very great help.

Flow Measurement with Orifice Meters, by Reid F. Stearns, Robert M. Jackson, Russell R. Johnson and Charles A. Larson; 350 pages; illustrated; size 7 by 10 in.; cloth binding; published by D. Van Nostrand Company, Inc., 250 Fourth Ave., New York 3, N. Y.; price $7.50.

This book is intended mainly for engineering, technical service and instrument groups concerned with process control, test work and plant start-ups in the petroleum industry. Its primary purpose is to provide these groups, so far as possible, with one reference containing all the infor-

De Laval Turbines at work!

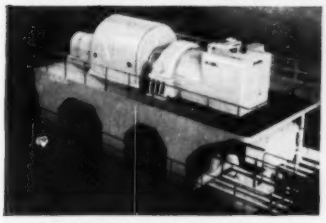


Meet the Grandaddy of all Turbines

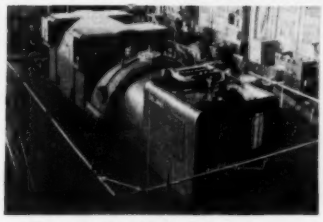
The first turbine-driven generating set to produce current on a commercial scale in the United States was this De Laval unit installed at the Chicago World's Fair in 1893. Grandad was a fast man in his day too . . . he delivered 10 hp at 24,000 rpm. Just four years later, four De Laval 100 hp turbine generators operating at 2840 psi, 750° F and two 50 hp turbines operating at 1420 psi supplied all the power for the Stockholm Exhibition. That is high pressure, high temperature operation even by today's standards!

Next time you're in our neighborhood stop in and see Grandad. He is on display in our reception room. Then let us take you through our shops . . . there you'll see how the finest turbines in the country are built.

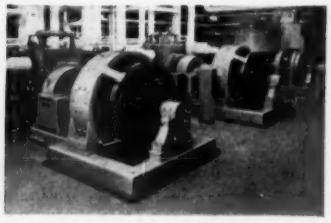
and here are a few of his Grandsons—



7500 KW De Laval turbine generator installed in the municipal power plant of the city of Lubbock, Texas. The 15 stage turbine is designed for 600 psi, 825° FTT.



This 11,500 KW De Laval turbine generator and another just like it will soon be supplying power for one of our key Naval bases.



Power for a New England textile mill is generated by these three 1000 KW De Laval geared turbine generators.

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

DE LAVAL

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

DL 122

When choice materials are scarce

you'll be glad you own

The New

ROTOJET®

TUBE CLEANERS

Rotojet owners can expect little or no maintenance problems during the critical times ahead. Simple design has always been a basic feature of Rotojet Motors, which have only two moving parts. That is a very important advantage, especially when quality materials for replacement parts are in short supply.

Replacement parts have always been available for Rotojet Cleaners. During our 40 years of tube cleaner specialization, prompt, efficient service has earned us the good will of our thousands of customers. To help owners of old and new Rotojet equipment to get maximum service, we have prepared a folder showing various accessories which will prolong the life and improve the performance of tube cleaners. We invite you to write for a free copy.

SEND FOR NEW ROTOJET BULLETIN

THE SECRET

ROTOJET Motor has only two moving parts, a shaft and a paddle. Positive contact between paddle and Rotocentric (egg-shape) bore cylinder prevents stalling at low speeds. No leakage. Delivers maximum power for air used.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue, Newark 1, N. J.

mation required for effective use of fixed-area orifice meters in common refinery applications. The authors are all engineers with Standard Oil Development Co. and previous editions of the present volume by Jackson, Johnson and Larson have been used within the company. The book is one of the Esso series.

The authors' experience has shown that the various discussions of orifice meters in the reports of ASME and AGA, and in various manuals, are not readily applicable to refinery metering because flow equations are not presented in the most convenient form and data supplied for flow calculations are often inadequate for this purpose.

Accordingly, they have out.ined in this book the procedures currently used in refinery operations, the physical data relating primarily to fluids used in petroleum refining. Principles and basic practices are, however, general in nature and may be employed as guides for fluid metering in other industries.

The principal subject divisions of the book, following the introduction, are: Derivation of Flow Equations; Applications of Flow Equations to Metering Problems: Evaluation of Variable Terms in Flow Equations; Principles of Operation of Commercial Meters; Interpretation of Meter Records; Orifice Meter Installations; Testing and Checking Meters; Special Metering Problems; Accuracy of Orifice Meter Installations; Supplemental Metering Information; Numerical Data and Physical Data. There is an extensive bibliography, lists of tables and symbols.

The illustrations are particularly good, including many perspective drawings and diagrams, and the curves and tables give all the necessary numerical data. These include data on many types of liquids and gases, not found in other publications.

This book is of the most practical nature with a minimum of theory and mathematics and a maximum of practical help in solving everyday metering problems in the refinery. It should be particularly useful there and should also help engineers in other fields.

1950 Supplements to Book of ASTM Standards, Parts 1 to 6(illustrated, 6 by 9 in.; paper binding; published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.; price $3.50 per part, $21.00 for 6 parts.

To keep up to date the triennially published Book of ASTM Standards, the ASTM in the intervening years issues Supplements to each part of the Book. The 1950 Supplements, recently issued in six parts, give in their latest approved form some 353 specifications, tests and definitions which were either issued for the first time in 1950 or revised since their appearance in the 1949 Book.

Part 1 — Ferrous Metals. 328 pp. Includes 66 standards covering steel (pipe and tubes, castings, bolting material, boiler plates, structural and rivet, bar, forgings, heat treated tires and springs, concrete reinforcement, corrosion and heat resisting, and metallic coated steel products); cast and malleable iron; ferro-alloys; metallography; and general testing methods.

Part 2 — Non-Ferrous Metals. 232 pp. Includes 42 standards covering copper and copper-base alloys (wire, rods and stranded conductors for electrical purposes, plate, sheet and strip, wire, rods, bars and shapes, pipe and tubes); aluminum and copper wire, rods and stranded conductors; aluminum and aluminum-base alloys; die-cast metals and alloys; and general testing methods.

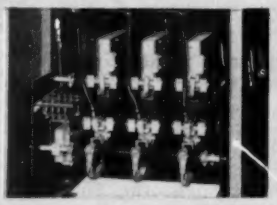
Part 3 — Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Wa-

YOU CAN BE **SURE**.. IF IT'S

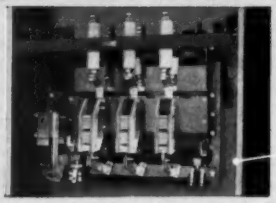
Westinghouse

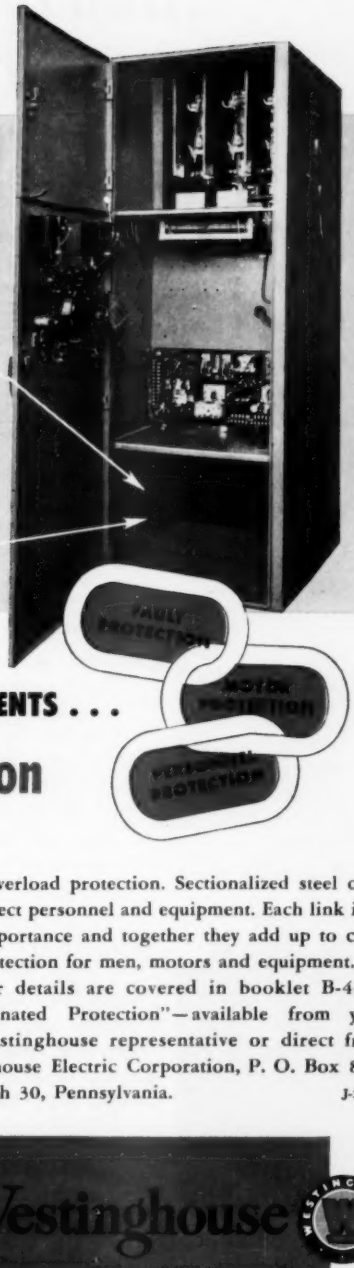
WESTINGHOUSE HIGH-VOLTAGE COMBINATION STARTER

Air-break Contactor for tough repetitive duty. Elimination of oil and tank cuts maintenance and inspection costs.



Oil-immersed Contactor for normal starting duty or where corrosive atmospheres, extreme dust and dirt, or excessive moisture are prevalent.





WHATEVER YOUR OPERATIONAL REQUIREMENTS . . .

YOU GET Co-ordinated Protection

Ten times an hour or ten times a minute . . . there is a Westinghouse High-voltage Combination Starter for your particular motor operation cycle. For normal motor stop, start and reverse, the Type DN-OH Oil-immersed Contactor will do the job. Where these motor operations are of a highly repetitive nature, the Type AH Air-break Contactor is the answer. With both types you get co-ordinated protection . . . in a single, self-contained unit.

Westinghouse Co-ordinated Protection is three-dimensional and interlinked . . . guards circuits, motors and personnel. Type BAL Fuses provide short-circuit protection—act as convenient disconnects. Magnetic Contactor controls motor—thermal relays supply overload protection. Sectionalized steel cabinets protect personnel and equipment. Each link is of equal importance and together they add up to complete protection for men, motors and equipment.

Further details are covered in booklet B-4673 "Co-ordinated Protection"—available from your local Westinghouse representative or direct from Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-27004

Westinghouse

HIGH VOLTAGE STARTERS

Treat Cooling Water *with Chlorine* — the Proven Way

HELP MAINTAIN MAXIMUM PLANT EFFICIENCY..

Hundreds of power plants and refineries have found chlorination by W&T the answer to heat exchanger slime problems. By eliminating slime forming microorganisms, maximum heat transfer is maintained in the condensers. The result — overall plant efficiency is kept at a maximum.

REDUCE LABOR COSTS...

High labor costs involved in frequent condenser tube cleaning are eliminated when chlorination is employed. Manhours used for tube cleaning can be utilized for other maintenance jobs, an important factor with the increasing manpower shortage.

REDUCE DOWN TIME...

Elimination of frequent shut-down for tube cleaning helps power plants stay continuously "on the line." When chlorination is employed, many plants find that outage for cleaning is reduced to once per year and then only for removing trash from tube sheets.

W & T Air Operated Visible Vacuum Chlorinator

Years of operation have proved the dependability and accuracy of W&T Chlorinators for cooling water treatment. Low maintenance and automatic program operation keep operating costs to a minimum. For information on how you can solve your slime problems, contact your nearest W&T Representative or write to:

CD-35a

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

terproofing Soils. 364 pp. Includes 68 standards covering cement; lime; gypsum; thermal insulating materials; glass and glass products; ceramic whitewares; natural building stones; masonry building units (brick, structural clay tile); pipe and drain tile; mineral aggregates and concrete; bituminous materials for highway construction, waterproofing and roofing; soils; magnesium oxychloride cements; thermometers; and general testing methods.

Part 4 — Paint, Naval Stores, Wood, Adhesives, Paper, Shipping Containers. 352 pp. Includes 54 standards covering pigments (mineral iron oxide, blue, green, red, and metallic); drying oils; shellac, varnish and varnish products; lacquer and lacquer materials; general paint tests; paint weathering tests; naval stores (rosin and liquid); wood; adhesives; paper and paper products; shipping containers; tests of building constructions; fire tests; thermometers; and general testing methods.

Part 5 — Textiles, Soap, Fuels, Petroleum, Aromatic Hydrocarbons, Antifreezes, Water. 596 pp. Includes 93 standards covering textile materials (asbestos, glass, rayon and estron, wool and general); soaps and detergents; coke; petroleum products and lubricants (motor and aviation fuels, light hydrocarbons, diesel fuels, hydrocarbon liquid solvents, distillate burner fuels, kerosine, illuminating, turbine and electrical insulating oils); greases; methods of measuring and sampling petroleum and petroleum products; industrial aromatic hydrocarbons; gaseous fuels; engine antifreezes; industrial water (definitions, analytical methods, corrosivity tests and methods of reporting results of analysis of industrial water); thermometers; and general testing methods.

Part 6 — Electrical Insulation, Plastics, Rubber. 296 pp. Includes 30 standards covering electrical insulating materials (shellac, tubes and molded materials, mineral oils, ceramic (glass) products, fabrics and papers); plastics (melamine-formaldehyde molding compounds, optical properties, molds and molding processes); rubber products (chemical analysis, aging and weathering tests, insulated wire and cable, compressed asbestos sheet packing); thermometers; general testing methods.

National Electrical Code 1951; 512 pages; illustrated; 6 by 9 in.; cloth; published by the National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass.; 1951; price $3.00.

This is the 40th Anniversary Edition of the National Electrical Code published under the sponsorship of the National Fire Protection Association.

The purpose of the Code is the practical safe-guarding of persons and of buildings and their contents from electrical hazards arising from the use of electricity for light, heat, power, radio, signaling and for other purposes. It covers the electric conductors and equipment installed within or on public and private buildings and other premises. The provisions of this Code constitute a minimum standard. Compliance with the rules and proper maintenance will result in installations reasonably free from hazard but not necessarily efficient or convenient.

The National Electrical Code was originally drawn in 1897 and has undergone many revisions since its first appearance. The 1951 Edition incorporates tentative interim amendments No. 88 and No. 89 and completely replaces the 1947 Code. It goes without saying that a copy of this book should be in the hands of every electrical worker who does electrical construction or who has under his care the operation of electrical equipment.

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

PHYSICAL PROPERTIES OF COPPER AND RED BRASS TUBES

Although many copper alloys are available today for use in fresh water, copper itself is still most widely used in numerous types of heat exchangers, evaporators and condensers.

Copper is preferred to the yellow brasses because it does not contain zinc and hence is not subject to dezincification. It has the highest thermal conductivity of the common metals and is specified where this property is desirable. Since it does not become covered with an insulating layer of rust, the heat transfer properties are maintained in service.

Copper and copper alloys are not subject to embrittlement at low temperatures required in refrigerating and cooling operations. Copper and red brass are also resistant to the common organic refrigerants containing halogens such as Freon, etc. Copper is also satisfactory for handling dry sulphur dioxide but is not suitable for ammonia.

In ammonia refrigeration systems, copper (and red brass and other copper alloys) in combination with low carbon steel (Duplex Tubing) is fast replacing steel tubing. The fresh cooling water is handled on the copper side while ammonia comes in contact with the steel side. This combination of metals has the advantage of better heat transfer properties than steel tubing itself. Copper is less subject to fouling by algae and bacteria than steel. Where strength and corrosion resistance to flue gases are desired, Duplex Tubing with steel to the gases and copper towards the water side, is giving satisfactory results as compared with steel boiler tubes.

Copper is also widely used in low pressure feed water heaters and hot water heaters because of its good resistance to corrosion by steam, condensate, and water.

Arsenical copper is preferred where its service records indicate its superiority. In general the various grades of copper show essentially the same corrosion resistance.

Copper is widely used in sugar refining operations where traces of ammonia may lead to stress-corrosion cracking of the yellow brasses.

COMPARATIVE PHYSICAL AND MECHANICAL PROPERTIES OF DEOXIDIZED COPPER, ARSENICAL COPPER AND RED BRASS

ANALYSIS	Deoxidized Copper 105	Arsenical Copper 108	Red Brass 85
Copper	99.9	99.4	85.0
Zinc			15.0
Phosphorus	0.02	0.02	
Arsenic		0.3	
MECHANICAL PROPERTIES			
Tensile Strength—Hard Drawn	45,000	45,000	—
—Light Drawn	37,000	37,000	—
—Soft	30,000	30,000	40,000
Yield Strength—Hard Drawn	40,000	40,000	—
—Light Drawn	30,000	30,000	—
—Soft	8,000	8,000	12,000
Elongation % in 2" Hard	25	20	—
Soft		47	45
Contraction in Area % Hard		48	
Soft		62	76
Rockwell Hardness—Hard	F77	F77	—
—Soft	F40	F42	F71
Elastic Limit—Soft	9,000	9,000	15,000
Modulus of Elasticity in Tension x 10^6	17	16	15
PHYSICAL CONSTANTS			
Density @ 68°F lbs./cu. in.	0.323	0.323	0.316
Specific Gravity	8.94	8.89	8.75
Melting Pt. °F Liquidus	1981	1978	1880
Solidus	—	—	1810
THERMAL CONSTANTS			
Coefficients of Thermal Exp. per °F from 68°F to 572°F x 10^{-6}	9.8	9.8	10.4
per °C from 20°C to 300°C x 10^{-6}	17.7	17.7	18.7
Thermal Conductivity at 68°F BTU/sq. ft./ft./hr./°F	196	112	92
Calories/cm^2/cm/sec/°C	0.81	0.46	0.38
Thermal Capacity (spec. heat) @ 68°F BTU/lb./°F	0.092	0.092	0.09
@ 20°C cal./gm./°C	0.092	0.092	0.09
ELECTRICAL CONSTANTS			
Resistivity ohms/mil foot @ 68°F (annealed)	12.2	24	28
Conductivity % IACS @ 68°F (annealed)	85	45	37
(annealed) megmho-cm^3 @ 20°C	0.493	0.261	0.215
Resistivity, micro-ohm centimeters @ 20°C (annealed)	2.03	4	4.7
Color	Red	Red	Reddish
FABRICATION PROPERTIES			
Cold working	Excellent	Excellent	Excellent
Hot working	Excellent	Excellent	Good
Hot working Temp. °F	1400-1600	1400-1600	1450-1650
Hot working Temp. °C	750-875	750-850	800-900
Machinability rating	20	20	30
Soft soldering	Excellent	Excellent	Excellent
Silver brazing	Excellent	Excellent	Excellent
Oxyacetylene welding	Fair	Fair	Good
Carbon arc welding	Good	Good	Good
Resistance welding	Poor	Poor	Poor
Polishing	Good	Good	Good
Annealing Temp. °F	700-1200	900-1250	800-1350
SPECIFICATIONS			
A.S.T.M.	B-111-50	B-111-50	B-111-50
U. S. Navy			
Federal			

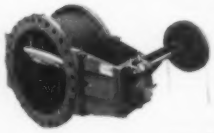
Red brass is superior to the yellow brasses as far as resistance to dezincification is concerned. It also has a somewhat higher heat conductivity than the yellow brasses but less than copper. In fresh waters, red brass and copper are often interchanged with satisfactory results.

The accompanying table gives the physical and fabrication properties and specifications of Deoxidized Copper, Arsenical Copper and Red Brass, and should be helpful to design engineers.

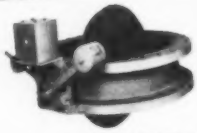
Tensile and Yield Strength values meet minimum engineering requirements. (8141)

R-S valvEvents

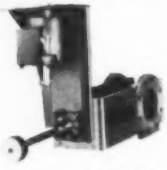
• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



WATER SERVICE—No. 825—36-inch 125-pound cast iron valve equipped with 18—8 shafts, bronze bushings and rubber seat for 85-pound drip tight shut-off.



EMERGENCY OIL SERVICE—No. 628—solenoid trip valve. Should the solenoid function, the latch is tripped which causes the counter-weight to open or close the valve by gravity. Available in any metal or alloy and in various sizes for emergency shut-off or vent for air, gas, steam, oil, and water.



700° F. EXHAUST GAS SERVICE—No. 826—6-inch 125-pound R-S "H" metal valve used on small turbine generator. Equipped with 18—8 shafts, hastelloy bushings, finned lubricated stuffing box and solenoid trip mechanism.

STEAM SERVICE—No. 677—1500-pound welding end steel valve for superheated steam—A. S. M. E. Standards.

SEMI-SOLID SERVICE including abrasive and corrosive materials.

R-S VALVES
Control and Shut Off Practically Any Material

The beveled vane seats firmly at a 12½° angle and is closed from a fully open position through 77½° of arc by either manual or automatic operation. A metal-to-metal seat gives satisfactory commercial shut-off. When required, Monel or stainless steel can be welded to the vane periphery and a babbitted seat used in the valve body. Drip tight or bubble tight closure can be obtained with a rubber seat.

Power controlled prime movers delivering the necessary foot pounds of torque open or close these self-cleaning valves at any desired speed from one second to eight minutes according to requirements. Pressures range from 2 to 2500 psig and temperatures from minus 300° F. to plus 2000° F.

Such simplicity of design, adaptability and operating ease are the reasons why R-S Valves can be installed to control and shut off the volume and pressure of any material that flows or is forced through a pipe.

Obtain full details from your R-S representative.

R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary

DISTRICT OFFICES IN PRINCIPAL CITIES

HELPFUL BULLETINS

(*Continued from page 38*)

127 Lead-Calcium for Storage Batteries — Bulletin 1442 is a 4-pp article by U. B. Thomas, Jr., of Bell Telephone Laboratories, Inc., on the new battery-plate alloy, lead-calcium. Batteries using this plate are being produced for telephone, power plant, alarm system applications. Providing graphs and test data, article reports on development of the alloy for battery-plate grids. Explains how new alloy reduces self-discharge in batteries; gives details on mechanical properties of lead-calcium; tells why grids of this alloy are not weakened in use. Gould-National Batteries, Inc.

128 Motor Repair Equipment — For plants having their own motor repair shops Form 500, 8 pp, provides practical descriptive and application information on coil winder drives, coil winder heads, armature and stator holders, growlers, insulation formers and related items. Includes references to specific literature on each type of equipment. Crown Industrial Products Co.

129 Reciprocating Compressor Drive — Publication 1200-TEC-1111, 12 pp, presents the application of direct-connected synchronous motors to reciprocating compressors. Discussion deals largely with consideration of proper rotor flywheel effect as a preventive measure for voltage fluctuations when driving reciprocating compressors with such motors. Includes examples complete with formulas, sample calculations, reference curves. A worthwhile addition to the power engineer's reference library. Electric Machinery Mfg. Co.

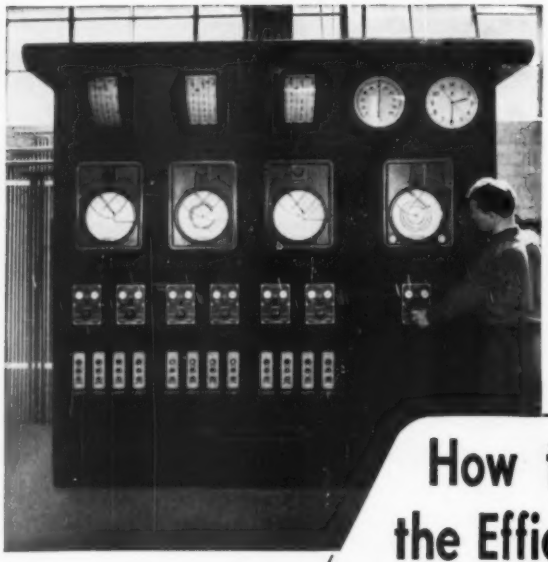
130 Cables for Coal Mining — Form W-51-7 is a 52-pp engineering catalog on electrical wires and cables developed especially for the coal mining industry but applicable where working conditions offer similar problems. Includes performance data and specifications on insulation and jacket compounds, portable cords and cables with voltage rating to 5000 v. Also covers shielded portable cables, welding cables, bore hole cables. Data on splicing and patching, current carrying capacities, conductor resistance temperature correction factors. Electrical Wire and Cable Dept., U. S. Rubber Co.

131 Planning a 4-H Program? — Fourteen-pp Bulletin B-5450, describing educational aids for power supplier rural programs, lists free and low-cost materials that can be used by 4-H Club members and leaders and vocational agriculture classes in furthering power supplier cooperation with rural youth programs. Illustrates and describes handbooks, charts, leaflets, instruction manuals on all phases of electric living on the farm, in the home. Sound movies that can be borrowed are outlined. Westinghouse Electric Corp.

132 "Custom Built" Stock Panelboards — Eight-pp Bulletin 513 discusses manufacturer's P2B and P3B Push-matic Electri-Center (lighting) panelboards. Points out that these panelboards are now available immediately from local distributors' shelves — the customer just specifies type of interior, front and number and rating of circuit breakers desired. Bulletin also describes features of these panelboards, stresses push-button switching, lists 5 catalog numbers that fill any panelboard requirement to 42 circuits. BullDog Electric Products Co.

133 Modern Lighting Maintenance — "The Why, When and How of Modern Lighting Maintenance," 12 pp, emphasizes the high cost of low lighting maintenance standards and stresses advantages of planned maintenance of both light sources and reflecting surfaces. Shows how such a program saves both time and useful light. Outlines an eight-step program of planned fluorescent lighting maintenance. Also stresses advantages of planned group replacement of lamps as compared to "one-at-a-time" replacements. Lighting Div., Sylvania Electric Products Inc.

Make better water level reading
positive—mistake-proof—with
EYE-HYE
Remote Reading Indicator
Gage reading at eye-height any reasonable distance from drum
Easy to read, like conventional gage
Illuminated green fluid gives sharp clear indication
Simple, manometer principle, no complicated working parts
Easy to install, practically no maintenance
Models for all pressures, from 0 to 2000 pounds
Reliance EYE-HYE
Panel-mounted EYE-HYE
Wall-mounted EYE-HYE
Write for full data on EYE-HYE—tell us working pressure and control location
Complete line of Water Columns, Gages and other trim for all working steam pressures.
The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio



These Bailey Boiler Controls at the Chicago Pneumatic Tool Company's new plant in Utica, N. Y. insure efficient operation of three 25,000 lb per hour, 100 psi, spreader stoker-fired boilers

How to INCREASE the Efficiency of YOUR BOILER-ROOM DOLLAR

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better "boiler-room investment" efficiency —for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-111-0

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

OIL CONDITIONING

134 Fuel Dehydrator — This 2-pp illustrated bulletin provides complete information on a new dehydrator for diesel fuel, gasoline, kerosene and fuel oils, available in capacities to 600 gpm. Construction and dehydrating elements are fully described as well as the method for removing unexpected large slugs of water. Bowser, Inc.

135 Pipe Line Crude for Diesels — Bulletin 1266, 8 pp, explains how company's continuous centrifuge used with a unique fuel storage method makes it possible to purify pipe line crude oil for use as fuel in pumping station diesel engines. Provides a complete description of the method and equipment utilized, includes installation photos and flow diagrams, specifications. The Sharples Corp.

136 Catalyst for Petroleum — This 2-pp illustrated bulletin describes a catalytic cell for lubricating and fuel systems. Explains how catalyser works to prevent foaming, increase lubricating power, eliminate gums and varnish, provide other benefits. A. B. Hydrocarbon Systems.

ENGINES, GENERATORS

137 Generator Literature — Reprints of two articles authored by company engineers are now available. Form 05R7773, 8 pp, titled, "Supercharged Cooling of Generators," by Sterling Beckwith, describes some of the important steps that have been taken in the design of the first supercharged hydrogen-cooled generator. Form 05R7776, "Five Stages to Stability," by H. D. Timm, explains how discrepancies in generator output voltage are corrected by a series of amplifying stages in the Regulex regulators. State choice, or both. Allis-Chalmers Mfg. Co.

138 Four-Cycle Diesels — Design and operating features of manufacturer's one-, two- and three-cylinder Type 4FS diesel engines are presented in 12-pp Bulletin 194. Installation photos show typical applications, and sectional views show construction details. Also contains pictures of all main engine parts, complete specifications. Discusses low fuel consumption, full pressure lubrication and other advantages. Nordberg Mfg. Co.

HEATING, COOLING

139 Heat Exchanger Applications — Here's an 8-pp catalog describing manufacturer's heat exchangers in relation to their use for heating and cooling, condensing and evaporating. Because most industrial heat exchangers are custom-built, this booklet makes no attempt to illustrate their wide variety. Instead, it presents the basic components — heads, shells and tube bundles — so as to simplify the selection and specification of heat exchangers for any heat transfer application. Special attention is given tank heaters and fuel oil heaters. Superior Combustion Industries, Inc.

140 Where Heat Must Be Spread — Selection and application of company's Torridor blower type unit heaters are explained in Bulletin DS-327A, a revised booklet providing complete capacity information and performance data on units of 100,000- to 1,500,000-Btu capacities. Torridors are suggested for large spaces where air must be spread over great distances. Serving as both heating and ventilating units they can be used for a variety of special applications. Models described deliver heat from floor, wall or ceiling, directly or through ducts. Shows 10 outlet arrangements. Includes mechanical and engineering specifications. The Trane Co.

141 Heating Coils — A complete line of steam and hot water coils for a wide range of applications, in both standard and non-freeze types, is described in the 68-pp new edition of Bulletin DS-385. Outlines capacities, selection, performance, installation and dimensional data on all of company's coils. Standard types have a solderless bond, formed by mechanical expansion of seamless copper tubing into aluminum flat

When You Think of

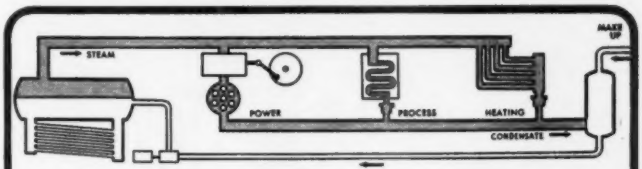
CORROSION PROTECTION for your STEAM SYSTEM

Think of

CORAVOL

(The Original* AMINE PROCESS)

Because CORAVOL Circulates to Control Corrosion



The CORAVOL ZONE—indicated by the shaded area in the diagram—includes every part of a steam system not accessible to boiler feed water treatment. It includes the boiler above the water line, steam lines, condensate return lines, radiators, valves, traps and equipment. This zone can now be reached and protected against rust and corrosive action—by CORAVOL.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special chemical formulas for . . . boiler feed water . . . foam prevention . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

CORAVOL circulating throughout your steam system protects it from corrosive attack. **CORAVOL** saves costly pipe repairs and replacements—maintenance labor—hours and days of shutdown loss. **CORAVOL** cleans out clogging rust deposits, improving heat transfer, restoring original capacity of lines and efficiency of valves and traps.

CORAVOL, the original* amine process, has the flexibility that lets it conform to each individual need. The **CORAVOL** you will use is formulated to do the best protective job under your own plant conditions.

*The use of **CORAVOL** in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

Chemical Water Treatment

WESTERN CHEMICAL COMPANY

717 Washington Street
Kansas City 6, Missouri

MAIL COUPON TODAY for
Complete Data about the CORAVOL Process

Western Chemical Company,
717 Washington Street,
Kansas City 6, Missouri

Send me full information about CORAVOL.

NAME _____

FIRM _____

ADDRESS _____

CITY _____ ZONE _____

STATE _____

an ACCO product

RUGGED...

• That's the best way to describe R-P&C Bar Stock Valves. These fine throttling valves provide precise, positive flow control. Long, low-cost, trouble-free service makes them ideal for meter, gauge, test, and general purpose use. Precision turned . . . from carefully tested metals . . . and suitable for a wide range of pressures and temperatures.

See your R-P&C distributor or write the nearest R-P&C district office for information.

ACCO

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

plate fins, a design said to contribute to high heat transfer and durability. Many installation photos included. The Trane Co.

BOILERS AND ACCESSORIES

142 **New Type Boiler** — Water tube boilers described in this bulletin are company's Type SB, designed for standard pressures of 200 and 250 psi. They are a development from manufacturer's "custom-made" boilers and intended to provide same benefits to small-to-medium installations previously available in larger instrllations. Features are described, dimensions given; arrangements for spreader-stoker and oil-firing illustrated. Dominion Bridge Co., Ltd.

143 **To Stop Blow-Off Waste** — This bulletin describes a rotary disc continuous blow-off unit, explaining how it works and discussing its advantages. A typical installation is described and pictured. The Uniblow Valve Co.

FILTERING

144 **Cloth Screen Dust Filter** — Bulletin 101 describes manufacturer's Dynaclone, a cloth-type filter for collecting industrial dusts. Discusses uniform suction, blasts of reverse air to prevent accumulation of dust in bags, other advantages. Explains how system works, how it can be applied to existing installations of company's dust filters. Lists 111 kinds of dusts handled by it. The W. W. Sly Mfg. Co.

145 **Standard Filters** — Form PL-200, describing company's Fulflo line of standard filters for microscopic clarification of industrial liquids and gases, provides detailed explanation of the honeycomb filter tubes incorporated. Describes single and multiple tube steel filters, oil burner filters, high capacity filters, rubber lined types, also brass nickel-plated types and filters for special applications. Includes sizes, capacities. Commercial Filters Corp.

MECHANICAL POWER TRANSMISSION

146 **FHP V-Belts** — Improved single-groove V-belts featuring straight sidewalls for more grip, and cords in the strength member held in a straight "power line" to increase life of belt and driven machine by eliminating vibration, are described in Bulletin 6830 B, a small folder. Standardized belt numbers and list of standard sizes included. Manhattan Rubber Div. Raybestos-Manhattan, Inc.

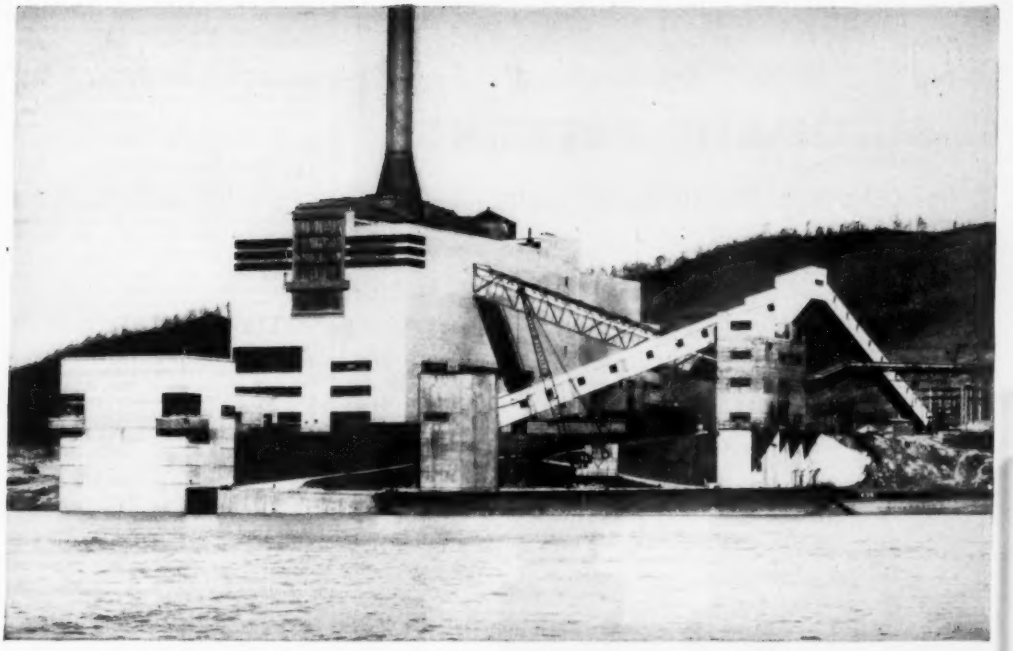
147 **Adjustable-Speed Drive** — Bulletin D-2311, 8 pp, points up efficiency-improving, cost-reducing advantages of packaged all-electric adjustable speed drives. Explains company's V*S drive, its economics, application and operational flexibility in providing adjustable speeds from a-c circuits. Discusses seven basic functions of this method of power transmission available in five types, in ratings from ¾ to 200 hp. Includes diagrammatic and tabular charts covering basic speeds and horsepower-torque characteristics of the drive. Reliance Electric & Engineering Co.

CONSTRUCTION, MAINTENANCE

148 **Non-Slip Flooring** — Algrip, an abrasive rolled steel floor plate described as non-slip even on steep inclines, is the subject of Form 3356, 8 pp. Discusses safety features; gives fabricating data, sizes, allowable loads. Pictures some applications. Alan Wood Steel Co.

149 **Threshold Reference Book** — Complete and practical information on thresholds is provided in this 28-pp pocket-size booklet. Illustrated throughout with cross-section drawings and sketches, it shows various types of abrasive cast, extruded and rolled steel thresholds, typical installations, and types of tread surfaces available. Wooster Products, Inc.

150 **Wire Rope Assemblies** — Industrial Standards Catalog 5201, 24 pp,



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

Z.1.1

WORTHINGTON

WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters	Boiler Feed Pumps	Steam Turbines
Steam-Jet Ejectors	Water Treating Equipment	Surface Condensers

...for Dependable

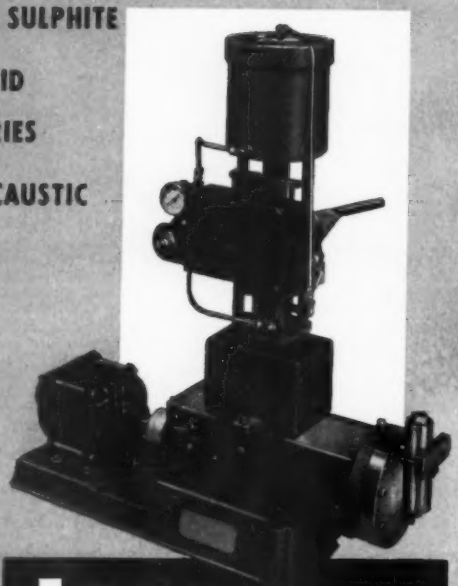
AUTOMATIC METERING

of CONCENTRATED SULPHURIC ACID

√SODIUM SULPHITE

√FILTER AID SLURRIES

√LIQUID CAUSTIC



Lapp

Auto-Pneumatic

PULSAFEEDER

No stuffing boxes to leak... no small orifices to clog... positive displacement for true metering... construction of materials which withstand the corrosive action of chemicals involved. That's the Lapp Pulsafeeder, the up-to-the-minute instrument-controlled piston-diaphragm pump for controlled-volume pumping of hard-to-handle chemicals. Auto-Pneumatic Control responds to instrument air pressure to establish pumping rate, controlled by flow-orifice meters, flow-positive meters, pH controls, flow variable-pH variable combinations, or other control instruments.

NEW BULLETIN AVAILABLE. Write for Bulletin 300, just issued. 24 pages of description, specifications, typical applications, flow charts. Lapp Insulator Co., Inc., Process Equipment Division, 580 Maple Street, Le Roy, N. Y.

illustrates and gives detailed specifications for wire rope with fittings permanently attached. Such assemblies are used for operating machinery and equipment controls, slings, hoists, and they consist of a length of company's Preformed wire rope with terminal attached to one or both ends. Booklet explains how Safe-Lock terminals are permanently swaged to the rope to form a bond stronger than cable itself. Macwhyte Co.

151 **Stud Welder Maintenance** — Catalog 1003 CC, a 12-pp handbook, is a companion piece to company's operating manual and said to be first booklet devoted exclusively to maintenance of stud welding equipment. Drawings, charts and photos accompany explanatory text. Tells how the gun works, how control mechanism works, provides circuit and wiring diagrams. Lists common troubles, their cause and correction. Basic sections cover general information, maintenance and accessories. Stud Welding Div., KSM Products, Inc.

152 **Metal Surface Protection** — This bulletin features an economical stainless steel coating for all metal surfaces, intended to solve severe corrosion problems. Includes general specifications, product information and test data covering its use with food products, oils and greases, petroleum derivatives, alkalis and organic and inorganic acids. Lists some of the applications for this coating. Steelcote Mfg. Co.

OTHER EQUIPMENT

153 **Mechanical Drive Turbines** — Recently-revised Bulletin H-16, 12 pp, covers manufacturer's Type YR mechanical drive turbines, giving dimensional data, general and material specifications. Sectional drawings show basic design and modifications, standard types of governors. An interesting history of the development of the steam turbine is also presented. Elliott Co.

154 **Hydraulic Setting Refractories** — This 12-pp illustrated brochure presents five of company's Firecrete products for casting special refractory shapes and three Blazecrete products for gunning and slap troweling applications. These are for services for 3000 F. Contains suggestions for solving maintenance problems as well as recommendations for casting shapes and linings. Photos show typical uses and illustrate handling methods. Text includes descriptive information, tabular data. Johns-Manville.

155 **Internal Downflow Purifier** — Condensed Bulletin 400 features the internal downflow type of company's Hi-eF purifiers designed to extend the life of reciprocating engines, turbines and super-heater tubes. Illustrates unit, tells advantages, operation; gives prices. The V. D. Anderson Co.

156 **For Clean, Dry Air** — The Model B-30 Condensifilter for dehydrating and cleaning compressed air used for operating instruments is detailed in Bulletin B-30. Cutaway illustrations showing design features, and operation of the device, accompany explanatory text. Component parts are illustrated and specifications given. Hankison Corp.

157 **Fresh Air Quick** — A device for moving large volumes of air quickly and economically for intermittent or emergency ventilation is described in Bulletin DP-5. Cites examples of its use in refineries, chemical and steel plants, utility companies etc. Mine Safety Appliances Co.

158 **Welding Alloys Directory** — Now available is the 16-pp "1952 Directory" of electrodes and welding alloys. Contains photos, data and technical information on a series of "Eutectic Low Temperature Welding Alloys" for use on cast iron, steel, alloy steels, copper, brass, bronze, aluminum, magnesium, hard and machinable overlays and for cutting all metals. Other pages are devoted to a chart of 100 of company's welding alloys, their main uses. Eutectic Welding Alloys Corp.

Three

waste water problems solved by

GRAVER

REACTIVATOR

Here was a particularly difficult problem of high solids in waste water in a large eastern process plant.

This waste water contains up to 1500 ppm of suspended solids and 3000 gpm were to be treated. The problems were:

(1) to prevent stream pollution,

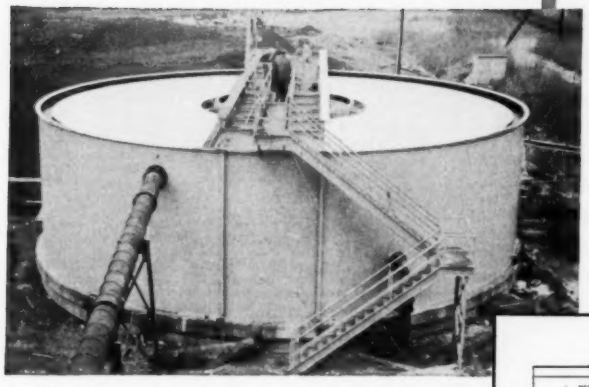
(2) to produce solids of the highest concentration for disposal,

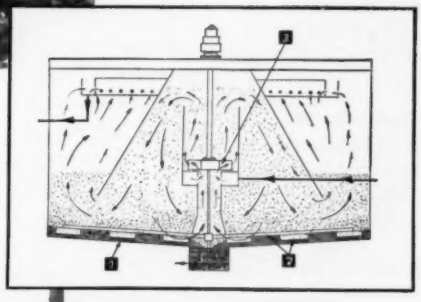
(3) to recover clear water for process use.

A Graver Reactivator was selected to solve this multiple problem. The Reactivator is doing the job so effectively that it delivers solids up to 14% by weight while producing an effluent suitably clear for recycling in the system, *without any chemical treatment.*

In plants all over the country, Graver Reactivators are effectively and economically treating raw water supplies and conditioning waste waters for reuse or for trouble-free disposal. These units can solve *your* liquid conditioning problem, too. Their distinctive design is described in Bulletin WC-103.

Write today for a copy and for free technical paper, "Some Economic Factors in Waste Water Treatment".





Three exclusive Graver Reactivator Features

1. *Full bottom area for solids concentration and collection.*
2. *Separately driven highly efficient sludge scraper and blades.*
3. *Positive and intimate contact of incoming water with sludge by variable speed sludge recirculation impeller.*

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

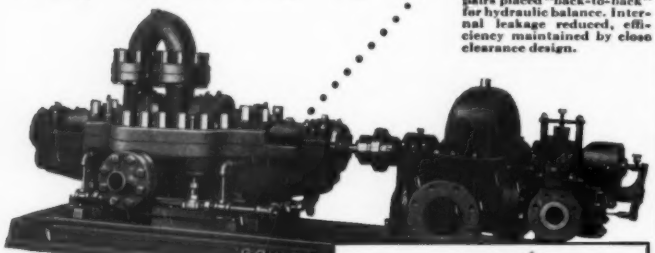
DEPT. PE-R, 216 WEST 14th STREET, NEW YORK 11, N. Y.

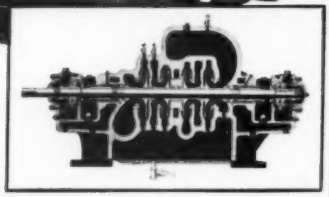
GRAVER

GW 456

Keep Efficiency Up —

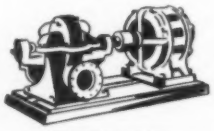
GOULDS Fig. 3360
Single-suction impellers in pairs placed "back-to-back" for hydraulic balance. Internal leakage reduced, efficiency maintained by close clearance design.



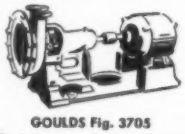


Costs down
with *Goulds*
High Pressure Centrifugal Pumps

Other GOULDS Pumps for Heavy-Duty Service



GOULDS Fig. 3450
These double-suction, single-stage Goulds centrifugals will handle up to 15,000 G.P.M. Heads up to 500 ft. Bulletin 721.2.



GOULDS Fig. 3705
Stainless steel pumps for handling acid and alkaline liquors. Capacities up to 600 G.P.M. Heads up to 160 ft.

GOULDS Fig. 3047
Nonclogging impeller of this vertical sump pump will handle water containing large solids or fibrous materials.

In power plant boiler feed service or other installations where high pressures and temperatures are encountered, it will pay you to specify Goulds High Pressure Centrifugal Pumps.

Low in cost and easy to install, they assure real economy. Goulds save you money while in operation, too. Their simple, durable construction provides years of 24-hour-a-day trouble-free service . . . means lower replacement costs and reduced maintenance for you.

The Goulds Fig. 3360, pictured above, is available in bronze fitted construction with heavy-duty, double ball bearings, in sizes 3″ to 8″, stages 2 to 8, capacities to 2250 G.P.M. Heads to 3050 ft. Bulletin 722.5 contains details and specifications. Write for it today.

MEMBER

Goulds PUMPS INC.
Seneca Falls New York

CATALOG LIBRARY

(Continued from page 46)

currents under short-circuit conditions, booklet stresses this interlinked protection, covering three classes of combination motor starters. Westinghouse Electric Corp.

241 Care of A-C Rotating Equipment — To promote intelligent, consistent maintenance of electrical machines, company offers Bulletin O5R7417, a series of articles by Fraser Jeffrey. Contents of the 24-pp booklet cover preventive maintenance and machine repairs, drying moist insulation, measuring insulation resistance. Allis-Chalmers Mfg. Co.

242 Buyers' Manual on Motors and Control — Fifty-pp Catalog GEC-1009 presents buying information on a carefully selected group of motors, motor starters, control accessories and electronic control. Ratings listed are those most frequently required. Excellent data on proper selection is provided. Illustrated. General Electric Co.

PUMPS AND COMPRESSORS

242-A Screw Pumps — Bulletin S204, 18 pp, describes and illustrates Warren-Quimby screw type rotary pumps. Provides sectional and exterior views, installation pictures, dimensions, engineering and selection data. Warren Steam Pump Co., Inc.

243 Controlled Volume Pumping — Illustrated Bulletin 151, 24 pp, on controlled volume pumping will be of interest to engineers whose plant operations call for pumping a controlled volume of liquid in amounts from 3 ml per hour to 50 gpm. Describes features of company's pumps and includes data for selecting pumps for specific applications, 170 chemicals. Milton Roy Co.

244 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data, vapor pressure tables included. Pacific Pumps, Inc.

245 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. Impellers, diaphragms, bearings and stuffing boxes are described. De Laval Steam Turbine Co.

246 Centrifugal Pumps — Twelve-pp Bulletin 715-1 presents manufacturer's support-head type centrifugal pumps, describing and illustrating construction details, and providing performance data, specifications and dimensions. These are single stage, ball bearing, enclosed impeller pumps for direct drive or belt drive; for general industrial use, water supply systems, booster service, air conditioning. Goulds Pumps, Inc.

247 Proportioning Pumps — A high pressure, low capacity reciprocating plunger pump for use where a controlled capacity of fluid is required is featured in this illustrated bulletin. Also describes a chemical feed packaged unit utilizing this pump. Specifications provided, as well as an application chart covering simplex and duplex models. The Bird-Archer Co.

248 Centrifugal Pump Pointers — Bulletin O8X7613 is a 30-pp instruction booklet covering the installation, operation and repair of manufacturer's single-stage double-suction centrifugal pumps. Recommends a regular inspection to be followed and includes a maintenance timetable based on continuous pump operation. A page is for use as a permanent record of the operator's pump and its performance. It is so arranged as to enable operator to see at a glance the life of any parts replaced and any improvement due to substitute materials. Also carries a quick reference guide listing 40 possible causes of trouble. Allis-Chalmers Mfg. Co.

LOW COST DEPENDABLE COAL HANDLING FOR PUBLIC UTILITIES

Salem Gas and Light Company, Salem, Mass., found a G-W Skip Hoist the ideal solution to the problem of conveying coal and coke to producer storage. The skip bucket keeps the producer-storage bin filled at all times . . . and does the job with maximum economy.

Gifford-Wood Skip Hoists . . . one of many G-W systems of materials handling . . . are low in initial cost . . . low in maintenance . . . long-lived . . . completely dependable. Public utility companies the country over are becoming increasingly interested in Skip Hoist handling of coke, coal and ashes where space is limited and both initial and operating costs must be kept at rock bottom.

This particular installation may not be the perfect solution to your own particular problem. Gifford-Wood, however, has specialized in the design, engineering and installation of all types of materials handling systems for 136 years. To have a Gifford-Wood Materials Handling Engineer survey your present method of moving materials, places you under no obligation and it may well be your first step toward lower operating costs and increased production.

GIFFORD-WOOD CO.

Since 1814
HUDSON, NEW YORK

NEW YORK 17, N. Y. 420 WASHINGTON AVE. • ST. LOUIS 1, MO. RAILWAY EXCHANGE BLDG. • CHICAGO 6, ILL. 565 W. WASHINGTON ST.

6616

When You Think of Materials Handling — Think of Gifford-Wood

What's a man's eye worth?*

$2500 . . . $5000 . . . $7500? Whatever the amount may be, the eyesight of your boiler room operators is too valuable to be endangered by shattering of ordinary gauge glass under today's high pressures. Resolve now to stop taking chances. Fit all water columns with SONDERGLASS, the safe gauge glass. Its double strength construction brings added safety to boiler room operation. In repeated tests SONDERGLASSES have been dipped into 450°F oil, then plunged into cold water without breaking! It resists clouding, discoloration and *erosion in the* **Danger Zone.* Genuine SONDERGLASS, which thousands of engineers know as the Safe Gauge Glass may be secured from your local distributor.

SONDERGLASS

THE SAFE GAUGE GLASS

PACKING
Chesterton
SERVICE

A. W. CHESTERTON CO., 6 Ashland St., Everett 49, Mass.

☐ I would like more data on SONDERGLASS
☐ Who is my local distributor?

Name _____
Company _____
Street _____
City _____ State _____

250 Compressor Selection Chart — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Shows recommended compressor bore and stroke in inches. Worthington Pump and Machinery Corp.

INSTRUMENTS AND CONTROLS

251 For Centralized Control — Bulletin 109 presents compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes and illustrates vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Co.

252 Putting the Ratio Totalizer to Work — Twelve applications of company's ratio totalizer in automatic control circuits are shown in 8-pp Bulletin 5450. This is a pneumatically operated control mechanism for combining input control pressures and spring forces to produce a single output control pressure. Hagan Corp.

253 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co.

254 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

255 Instruments, Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.

256 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains principle of operation. The Reliance Gauge Column Co.

257 Temperature Regulators — Twelve-pp Bulletin T, Catalog 80, describes manufacturer's line of regulators for controlling temperature of liquids and gases, giving their applications, operating characteristics, construction specifications, dimensions. Eight instruments are presented. Fully illustrated, includes selection and application chart. Foster Engineering Co.

258 For Determining Steam Consumption — Bulletin R-513 explains design, construction, installation and operation of manufacturer's rotary condensate meter, an economical means of determining steam consumption where all condensate can be captured. Includes size, dimension and weight table, simplified piping diagrams for both gravity, vacuum systems. American District Steam Co., Inc.

259 Steam Calorimeter — Bulletin 118 discusses an improved U-path calorimeter combining a throttling, separating and re-evaporating calorimeter in a single chamber. Explains construction and operation of the unit. Ellison Draft Gage Co., Inc.

260 Pressure Regulator — Bulletin 1-B, 8-pp discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations.

TWO TERRY TURBINES IN RECORD NON-STOP RUN AT CITIES SERVICE

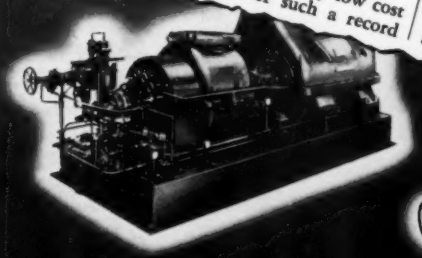
After 26 Months of Continuous Operation, Cost of Replacement Parts Only $78.00 for Each Turbine

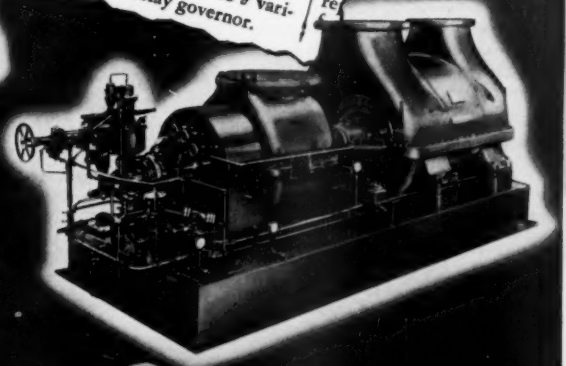
Two Terry turbines recently completed a record non-stop run at the East Chicago refinery of Cities Service Oil Company. Specially designed for driving air blowers on fluid catalytic cracking, they ran continuously *from initial start up*, day and night, for two years and two months. Throughout the entire run neither turbine suffered any noticeable reduction in efficiency.

On inspection, after shutdown, it was found that the only parts showing signs of wear were the shaft packing rings. These were replaced at a total cost of $78.00 for each turbine.

While this extremely low cost for repairs, after such a record run, could not have been anticipated, Cities Service had good reason to expect outstanding performance from Terry turbines. A four-year record of 216 Terry turbines at the Lake Charles refinery of this same company showed amazingly low maintenance costs. During this period, the yearly cost of replacement parts averaged only 1.4% of the initial investment.

The two turbines at East Chicago are rated 2450 horsepower at 5030 rpm. Each is equipped with a trip throttle valve, forced feed lubrication, and regulator for process control applied to a variable speed oil relay governor.





For more information about Terry multistage turbines, send for a copy of Bulletin S-146. No cost or obligation.

TERRY

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1193

THE NEW FOSTER 50-G2
Pressure Reducing Regulator
IS A NATURAL

It combines extremely close regulation and high inlet-to-outlet ratio, under varying loads — approaching *instrument control* — with the freedom from trouble, long life and easy maintenance of a *regulator*.

Here's Why:

Although the new 50-G2 is single-seated for tight shut-off, it has the throttling action of a double-seated valve. Full balanced pilot valve and short travel of operating steam to the main valve piston cut the lag in response, for extremely close following of the demand. Yet overtravel, flutter and chatter are eliminated by the mass of the piston, stabilizing multi-rings, and unrestricted area under the piston.

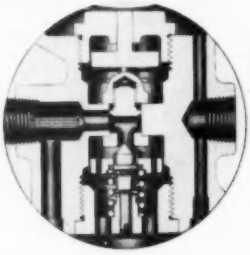
Pilot valve opening *with* the flow minimizes deadhead loss, and permits higher inlet-to-outlet ratio, for instance, 250# to 2#. May eliminate intermediate stage in low pressure applications such as deaerating water heaters, tank storage heaters and auxiliary exhaust systems.

All wearing parts are of stainless, corrosion and erosion resisting materials. New alloy metals mean less wear.

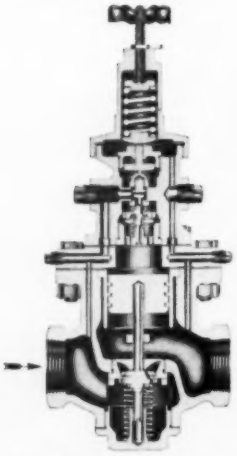
No special tools are needed servicing, and no outside media are required for operation.

Available for initial pressures 25—1200 P.S.I.G.; temperatures to 950°F; reduced pressures from controlled vacuum of 15" HG. to 600 P.S.I.G. with minor changes in top assembly; sizes ½" to 12"

For full information, ask for Bulletin G-101.



50-G2 Auxiliary or Pilot Valve Unit



Foster Type 50-G2 Internal Pilot Operated Pressure Reducing Regulator with Standard Top Assembly

FOSTER ENGINEERING

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . CUSHION CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SIRENS . . . SAFETY VALVES . . . FLOW TUBES

Also covers a compound regulator for controlling back pressure relief valve and high pressure make-up valve. Atlas Valve Co.

261 Composite Catalog — Illustrated Catalog 5000, 28 pp, describes principal instruments, control devices and related components manufactured by company's industrial division. Specifications of 100 measuring and control instruments, and valves are outlined. Included are new designs, the differential controller and Tel-O-Set controller family. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

PACKINGS

262 Manual on Packings — Containing 84 pp. of engineering and ordering information, Catalog 40 covers packings for practically every service. Includes packaging recommendation charts, conversion tables. The Belmont Packing & Rubber Co.

263 Metallic Packing — An elastic metallic packing for compressors, engines and pumps is described as to construction and advantages in this illustrated bulletin. Explains easy installation of the packing, illustrates installations. A. W. Chesterton Co.

264 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

265 Long Wearing Piston Packing — Form 4502, 8 pp, stresses use of company's composition cups for packing the pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature, pressure data. Darling Valve & Mfg. Co.

266 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. These, in turn, are illustrated with close-up photos and construction information, sizes, etc. Packings and gaskets are grouped on the pages according to recommended applications and services. Where packings have more than one application, cross-references are supplied. Johns-Manville.

267 Seals for Bearings — Complete information on manufacturer's Klosure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

FANS, BLOWERS

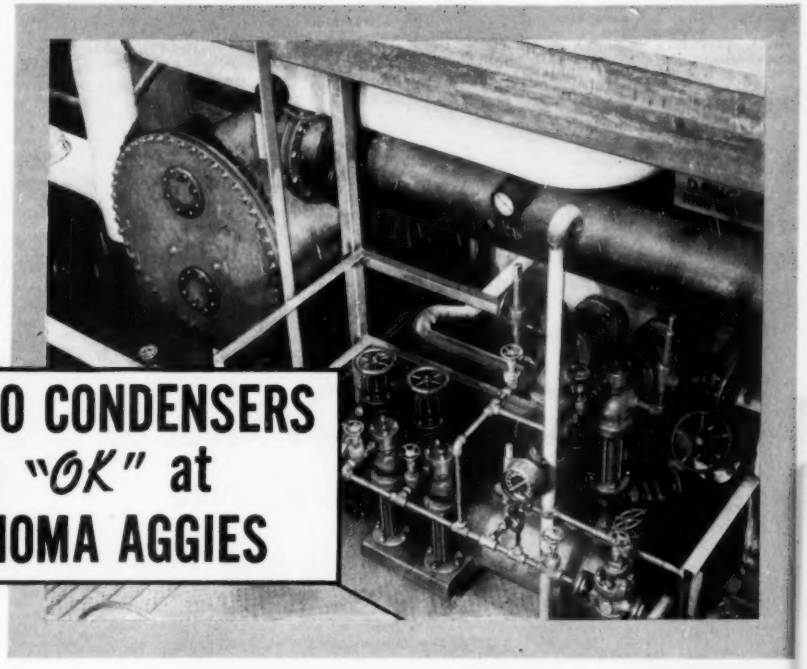
268 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. Gives construction features, drive arrangements. The Green Fuel Economizer Co., Inc.

269 Axial Flow Blowers — In this 6-pp illustrated bulletin are described axial flow blowers of both turbine-driven and motor-driven types. Gives capacity and dimensional data, operating range and specifications on both types. L. J. Wing Mfg. Co.

BOILERS AND AUXILIARIES

270 Steam Boilers — Form SG 128-749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of manufacturer's boilers. Cleaver-Brooks Co.

271 Re-Circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, de-



CONSECO CONDENSERS win "OK" at OKLAHOMA AGGIES

. . . find out what these dependable units can save in your plant . . .

Pictured above is one of the three Conseco Condenser and Ejector units installed in the power plant of the Oklahoma Agricultural & Mechanical College, Stillwater, Okla.

Each of these units, consisting of a two-pass, non-divided flow 2000 sq. ft. Conseco Condenser and a two-stage twin element Conseco Steam Jet Air Ejector, serves a 1500 kw. turbine. College engineers stamped them "OK" for dependable, money-saving teamwork.

This Oklahoma Aggie installation typifies Conseco's ability to meet modern power plant requirements. Conseco Engineers are specialists in heat exchanger equipment and their experience, together with Conseco production facilities, are available to assist you in securing worth-while savings in power production.

***WRITE** today for helpful engineering bulletins on Conseco Condensers and other equipment for power and processing plants*

Condenser SERVICE & ENGINEERING COMPANY HOBOKEN, N. J.

CONSECO

PRODUCTS INCLUDE: BOILERS . CLOSED HEATERS DEAERATORS . EVAPORATORS . STEAM JET EJECTORS

scribing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or load fluctuating. Explains operation, features. Combustion Engineering-Superheater, Inc.

272 Packaged Generators — Bulletin SB-38 presents company's Keystone model. Photos and sketches show complete unit, pressure element and details of its compact design. Gives advantages of two-drum water boiler, three-pass gas travel, automatic gas or oil burner. Erie City Iron Works.

273 Shop-Assembled Boiler — Eight-pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock and Wilcox Co.

274 Tube Expanders — Bulletin 380, 8 pp, covers manufacturer's line of tube expanders for maintenance of high pressure boiler tubes, superheaters, economizers, circulating tubes, steam generators, other equipment. Thomas C. Wilson, Inc.

275 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co.

276 Streamlined Baffle Walls — Bulletin BW-44, 20 pp, describes company's baffle walls, showing their application to modern boilers and for modernizing existing units. Fully illustrated with photos and drawings covering installations, remodeling designs. The Engineer Co.

277 Soot Blower Head — Illustrated Bulletin 485 describes a rotary soot blower head for improved boiler cleaning. Explains how head is designed to give maximum blowing pressure, is rugged, easily serviced, economical. Vulcan Soot Blower Div., Continental Foundry & Machine Co.

278 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, stream generators and other applications. Discusses heat transfer properties, high temperature use. Also discusses prevention of galvanic corrosion. Bridgeport Brass Co.

COAL AND ASH HANDLING

279 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

280 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co.

281 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's RotoGrate stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. More than 20 such installations are described, illustrated. Detroit Stoker Co.

282 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

283 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions, diagrams of arrangements included. Beaumont Birch Co.

284 Fly Ash Elimination — This 30-pp booklet presents manufacturer's "Multiclone" equipment (described as small-tube type of cyclonic dust collectors using centrifugal force for separating dust from gas stream) as a highly successful and economical means of separating fly ash — not as a panacea for all cinder and fly ash problems. Also gives data on single and double hopper installations. Western Precipitation Corp.

COOLING

285 Heat Exchangers — Bulletin 11.0-080 describes air cooled heat exchangers for condensing or cooling of steam or process vapors, natural gas, jacket water, lubricating oil, quenching baths. Equipment Div., J. F. Pritchard & Co.

286 Cooler with Fins — A new oil and water cooler and advantages of its improved design are described in 20-pp Bulletin 1020. Explains how company's LK-Fin Cooler, distinguished by use of helically-finned heat transfer elements instead of bare tubes, is a lighter, more compact and less costly unit. Diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface. The Griscom-Russell Co.

287 Heat Exchangers — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

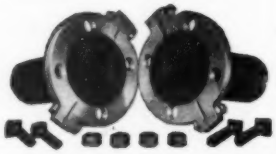
GOODALL
EXPANSION JOINTS
Right-Angle or "FLANG-LOK"

For All Standard Iron Pipe Sizes From ⅜" to 96" I.D.

In both Right-Angle and "Flang-Lok" styles, Goodall Expansion Joints are built with the exacting care that assures the utmost in durability, efficiency and safety under all service conditions. Long experience guides the selection of materials from which they are made; and craftsmen specialists apply unequalled skill to every detail of construction. Used under pressure, vacuum or both, they will stand repeated flexing, with maximum resistance to cracking and "setting."

Advantages of "Flang-Lok"

The combination of "Flang-Lok" End Expansion Joints and "Flang-Lok" Floating Flanges assures quick, easy installation even in extremely "close quarters." It is only necessary to turn the flange (not joint or pipe) to align bolt holes with connecting flange. As flange bolts are tightened, rubber end of joint is compressed over a broad area of connecting flange, providing a leak-proof seal having the widest margin of safety against rated pressures.



"Flang-Lok" Flanges are of cast iron or steel, and drilled to conform to A. S. A. drilling templates in 1" and larger. They are split type, with segments readily bolted together over end of joint, in preparation for actual connection. Design covered by U. S. Pat. No. 1883086.

Contact Our Nearest Branch for Complete Information

GOODALL RUBBER COMPANY

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

Branches: Philadelphia · New York · Boston · Pittsburgh · Chicago · Detroit · St. Paul · Los Angeles
San Francisco · Seattle · Portland · Salt Lake City · Denver · Houston · Distributors in Other Principal Cities

Est. 1870

COAL DUST STOPPED!

at 1/10 the usual cost

BEFORE

Dust conditions as they exist at a car dumper in a large mid-west utility when the Johnson-March System is turned off. Compare this unretouched photo with the one below.

AFTER

With the Johnson-March System in operation. Note how the absence of dust in this photo permits the sunlight to stream in from above. The J-M System stops dust at the source.

In this large public utility, a Johnson-March Dust Control System controls dust as no other system can control it. For unlike systems employing expensive ducts, fans and other cumbersome equipment, the J-M System *stops dust at the source—not after the dust has become airborne!*

The cost to this utility for positive dust control averages less than 1/10 the cost of other methods.

Hundreds of J-M installations are daily controlling the worst possible dust conditions. Former critical dust centers such as car dumpers, hoppers, crushers, belt galleries and coal piles are no longer the hazards they once were—possible sources of coal dust explosions or spontaneous combustion.

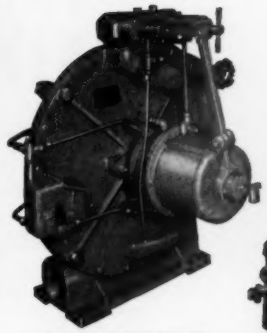
Our engineers will be glad to discuss your dust problems at no obligation. Write today for detailed information.

Johnson March

Specialists in Dust Control

Dept. PE-2 · 1724 CHESTNUT STREET · Phila. 3, Pa.

WING AUXILIARY TURBINES



Welded Steel Wing Turbine on Vertical Pump

OPERATING RANGES

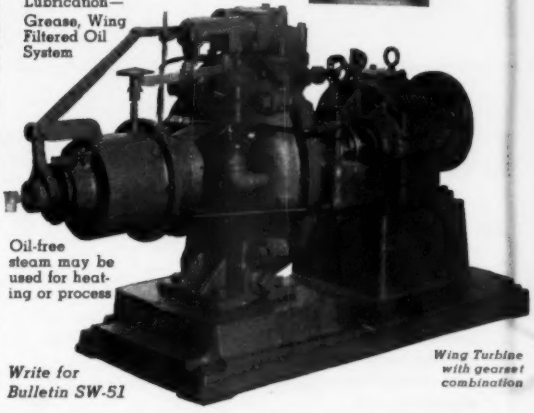
	Standard	Maximum Pressure
Horsepowers	100	150
Temperatures	525°	750°
Pressures	275	600
Back Pressures	50	50
Speeds	4000 RPM	4000 RPM

Capable of exhausting against HIGH BACK PRESSURES

Shafts—Horizontal or vertical

Rotation—Clockwise or counter-clockwise

Lubrication—Grease, Wing Filtered Oil System



Oil-free steam may be used for heating or process

Write for Bulletin SW-51

Wing Turbine with gearset combination

L. J. Wing Mfg. Co. 64 Vreeland Mills Rd. Linden, New Jersey

Factories: Linden, N. J., Montreal, Canada

Wing AUXILIARY STEAM TURBINES

BASKET TYPE

STRAINERS

- Large Strainer Area!
- Low Pressure Drop!
- Easily Cleaned!

Davis Basket Type Strainers are used on pressure and suction pipe lines for the protection of meters, valves, pumps and other equipment. The No. 76 Strainer has a cylindrical basket with perforated sides and bottom supported at the top by a flange. When the cover is removed the basket may be lifted out easily for cleaning. Large body passage reduces pressure drop across the strainer to a minimum. The size of screen perforations depends on the fluid being strained and the foreign matter in suspension. Ask for recommendations.

DAVIS No. 76 STRAINER

SIZES
½" to 14"

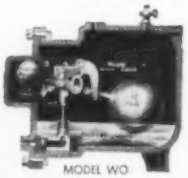
DAVIS REGULATOR CO.
2508 S. WASHTENAW AVENUE • CHICAGO 8, ILLINOIS

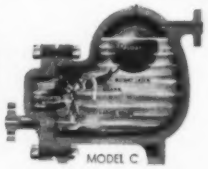
Nicholson W. O. Traps Are

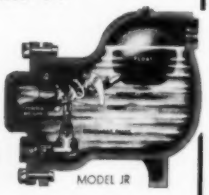
LEAKPROOF IN SUPER HEAT

Nicholson weight-operated traps will not leak live steam, even though body may become completely dry due to re-evaporation. Unlike most bucket and float traps, Nicholson units do not depend on buoyancy of float to raise valve. Their extremely large orifices also keep valve clean, preventing blow-through. Working parts of stainless steel.

3 TYPES, for every heavy-duty use; pressures to 1500 lbs. Also for air and gasoline.


MODEL WO


MODEL C


MODEL JR

Catalog 751 or see Sweet's

160 Oregon St.
Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.
TRAPS · VALVES · FLOATS

288 Cooling Towers — Bulletin AQ-50 is on packaged water cooling towers in 3 to 50 t sizes. Gives specifications for the tower and discusses special features. Also provides dimensional and application data. The Marley Co., Inc.

289 Spray Nozzle Systems — Recooling spray nozzle systems for use in plants operating condensers or using large quantities of water for cooling, are covered in 8-pp Bulletin 6A-SP. It details design, application, construction, and operation of spray nozzles, and diagrams typical spray pond arrangements. Sizes, dimensions, capacities, and spray nozzle patterns are included in tabular form. Includes cooling performance curves for various temperature ranges. Schutte and Koerting Co.

COMMUNICATIONS

290 Civil Defense Communications — Form G93-122, 12 pp, pictures typical communications systems now in use which can be coordinated into a dependable emergency communications network in any community. Describes company's technical advisory service for civil defense radio communications and lists district representatives available to analyze existing systems and form them into a single emergency network. Electronics Dept., General Electric Co.

291 Power Plant Intercom System — A communication system custom tailored to individual plant conditions and designed for two-way conversation over microphones and receivers, as well as paging, is described in this 25-pp booklet. Text tells how system is easily installed and is adapted to different noise levels of a power plant. Photos show installations of paging equipment. Gai-Tronics, Inc.

CONDENSERS

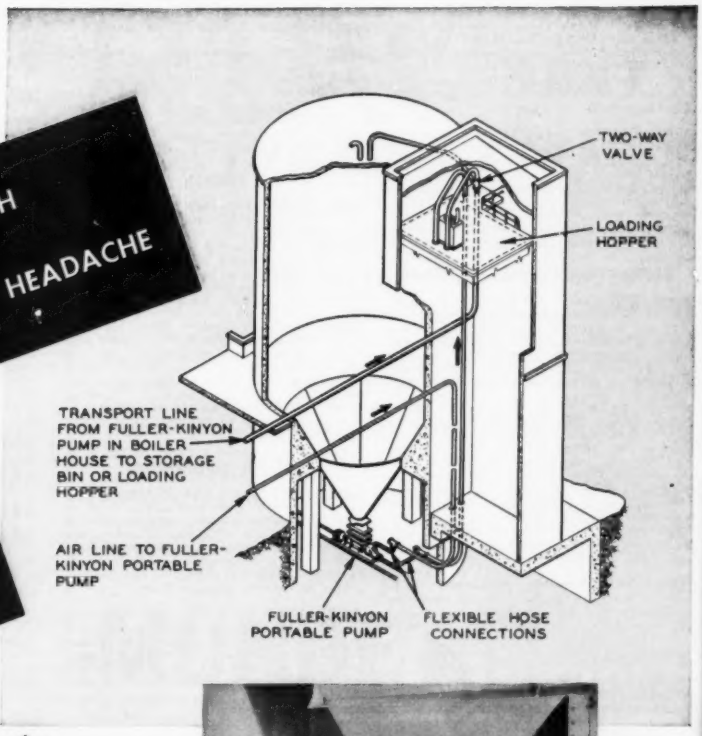
292 Steam Condensers with Reserve Flow — Eight-pp Catalog 410-1 describes a "self-cleaning" reverse-flow condenser for power plant service, designed to virtually eliminate cleaning downtime and, in the case of divided water box condensers, eliminate operation at partial load. C. H. Wheeler Mfg. Co.

293 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles, condensing water, raw water cooling, recirculation and removal of condensate. Foster Wheeler Corp.

294 Steam Condensers — Bulletin 102, 24 pp, presents manufacturer's steam condensers and includes photos of typical installations as well as engineering data, discussion of air removal equipment, and chapter on condenser maintenance. Company's Wizard injector to seal small leaks while condenser is in operation, air erosion eliminators, divers lights and port gages are also described. Condenser Service & Engineering Co., Inc.

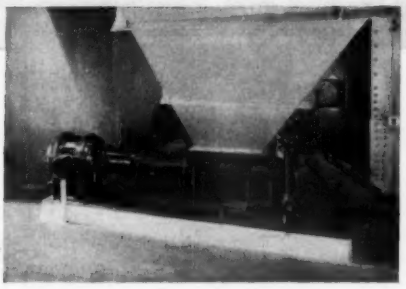
295 Condenser Tubes — Excellent factual information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper tube installation are presented, as are specifications, conversion tables, weights of tubes and alloys, formulas, terminology. Scovill Mfg. Co.

296 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances to assure longer life and reduce maintenance and replacement costs. Includes useful table of estimating data. Revere Copper and Brass, Inc.


TWO-WAY VALVE
LOADING HOPPER
TRANSPORT LINE FROM FULLER-KINYON PUMP IN BOILER HOUSE TO STORAGE BIN OR LOADING HOPPER
AIR LINE TO FULLER-KINYON PORTABLE PUMP
FULLER-KINYON PORTABLE PUMP
FLEXIBLE HOSE CONNECTIONS

Fly-ash storage and handling facilities. Fuller-Kinyon Portable Pump for conveying from present storage bin, or future bins, to loading hopper for bulk-car loading.

Fuller-Kinyon Stationary Pump installed in boiler house.



Fly ash, once a nuisance to generating stations, is becoming a source of profit today. Now, concrete products manufacturers are using large quantities of it—and demanding even more.

Handling this once-valueless waste was a tough, dirty, expensive job—until Fuller-Kinyon pumps took over the task of conveying it. From collector hoppers to storage bins or to bulk-car loading hoppers—Fuller-Kinyon pumps convey fly ash and send it anywhere, cleanly, efficiently, around corners, in any direction.

If your plant produces fly ash, in quantity, call in a Fuller Engineer. He'll discuss recovery and disposal—recommend whatever equipment may be needed. There is no obligation.

FULLER COMPANY, Catasauqua, Pennsylvania • Chicago 3—120 So. LaSalle St. • San Francisco 4—420 Chancery Bldg.

fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS • COMPRESSORS AND VACUUM PUMPS • FEEDERS AND ASSOCIATED EQUIPMENT

P-126

7257

TURBINES, GENERATORS

297 Multi-Stage Turbines — Six-pp Bulletin S-147 describes two of company's smaller-frame multi-stage turbines, both of the impulse type. Construction details are illustrated and described in detail. The Terry Steam Turbine Co.

298 Turbine Generators — Bulletin H-18, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical turbine condenser installation arrangement. Elliott Co.

REFRACTORIES, INSULATION

299 Refractory Brick — Electric furnace fused refractory bricks and their use is described in Form 862, 16 pp. Gives installation procedure on a high quality silicon carbide brick for boiler furnaces and gas generators. Also describes a fused aluminum brick of high refractoriness. Fully illustrated. Norton Co.

301 Boiler Settings — Excellent reference material on boiler operation and maintenance is provided in 24-pp "Boiler Settings with Plastic and Castable Refractories." Contains numerous cross-sectional drawings, charts, technical illustrations and other data in the field of plastic and castable refractories and their applications. Also presents information about refractory manufacture, design and installation. The Ramtite Co., Div., The S. Obermayer Co.

302 Incombustible Material — "The Story of Kaylo," 24 pp, describes company's new basic material, an hydrous calcium silicate product, covering some of the many uses for this incombustible material in construction and industrial fields. Tells how product was developed, describes its properties, tells densities available for thermal, insulating and structural applications. Kaylo Div., Owens-Illinois Glass Co.

303 Industrial Insulations — Selection and application information on insulating materials is presented in this 28-pp illustrated catalog. Covers block and blanket insulations, insulating cement, low pressure coverings, felt, other products. Gives specifications, temperature ranges, recommended thicknesses, prices. Baldwin-Hill Co.

TOOLS

304 Screwdriver Handbook — Besides providing full ordering information, 32-pp Catalog SD-551 serves as a reference encyclopedia on screwdrivers, nutdriver kits and other hand tools. Book is profusely illustrated in color and punched for filing in binder. Includes a handy screw and screwdriver reference chart. Vaco Products Co.

305 Pipe Tool Book — This is the latest edition of company's catalog and data book giving information on pipe and bolt machines, power units, ratchet threaders, reamers and cutters, other power and hand tools. Includes popular "operating guide" section. Fully illustrated with easy-to-grasp drawings, clear technical copy. Beaver Pipe Tools, Inc.

OTHER EQUIPMENT

306 Refrigerant Gas Purgers — How air and other non-condensables get into refrigeration systems, adverse effect of this on operating costs and efficiency, and how company's forged steel purger works to prevent this are covered in 8-pp Bulletin 192. Includes installation data, specifications and prices. Armstrong Machine Works.

307 The ABC of CO_2 — An interesting text covering role of carbon dioxide in combustion efficiency, 16-pp illustrated Bulletin 452 discusses theoretical vs practical perfection of combustion and tells how to determine percentage of CO_2 in flue gases. CO_2 as a basis for figuring heat and fuel losses is also described and method of determining such losses explained. Included scales of total heat losses of various types of coal, fuel oils and gas. The Hays Corp.

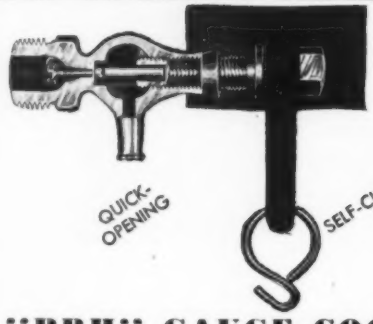
308 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, with tube bundles removable. Davis Engineering Corp.

309 Chlorination for Power Plants — Form RA-2061-C is a 20-pp technical article, "Recent Developments in Chlorination and Equipment for Power Plants." Discusses such subjects as industrial water chlorination, the desliming processes, air pilot chlorinator operation, organic slimes and scales, chlorine ammonia reactions, chlorine residual recording. Illustrated with photos of equipment, performance charts, diagrams. Wallace & Tiernan Products, Inc.

310 Fundamentals of Hydraulics — Technical Bulletin B-4, 44-pp covers hydraulic systems, maintenance trouble-shooting and selection of proper fluids. Besides offering reference data to engineering personnel, this book is suggested as a training manual for maintenance supervisors, operators. It features phantom and cutaway drawings illustrating functions of basic types of valves, pumps, hydraulic motors, torque converters. Sun Oil Co.

311 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's preheater, discusses its application to boiler plants. The Air Preheater Corp.

312 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.



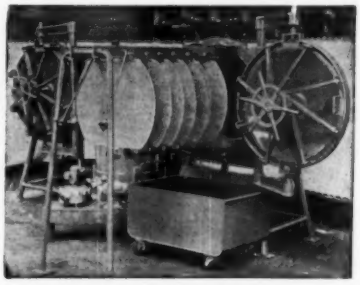
"PBH" GAUGE COCK

A gentle pull opens this sturdy, long-wearing gauge cock and an adjustable weight automatically closes it when you let go. Removable monel metal seat and copper valve pencil insures leak-tight service.

Write today for catalogue and prices

The PAUL B. HUYETTE CO., Inc.
401 N. BROAD ST. EST. 1896 PHILADELPHIA, PA.

WATER GAUGES—*Vertical and Inclined*
GAUGE-GLASS PROTECTORS • AIRTITE
BOILER WALL COATING • WATER COLUMNS •
BOILER ALARMS, INSTRUMENTS & CONTROLS



EMULSIFIED OR FREE OILS
Effectively Removed from Condensate with the
BLACKBURN-SMITH REFINER

OUTSTANDING ADVANTAGES
1. Breaks the tightest emulsion of oil in water
2. Reduces contamination to less than .1ppm.
3. Produces pure, clean condensate. 4. Saves boiler tubes

Contaminated Condensate Formerly Wasted Can Now Be Re-Used After Filtration Through the Refiner

Proved in service . . . saves heat units and fresh water . . . no backwashing . . . reduces boiler maintenance costs . . . improves boiler efficiency . . . simple and inexpensive to operate . . . requires little space.

Write for catalog. Engineering assistance gladly furnished

THE BLACKBURN-SMITH MFG. CO., INC.
98 RIVER STREET, HOBOKEN, NEW JERSEY
Subsidiary of Condenser Service & Engr. Co., Inc.
HOBOKEN 3-4425 RECTOR 2-9360

313 Plus Protection — Vol. 2, No. 2 of the Magnesium Anode is a 2-pp discussion of the value of supplemental cathodic protection for coated pipelines, using magnesium anodes as the source of current. Dowell, Inc.

314 Transmission Belting — Catalog M-9922, 28 pp, gives design, engineering and performance data on transmission belting. Tables on belt speeds, arc of contact, friction, horsepower correction, and service factors. United States Rubber Co.

315 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures, other information. The International Nickel Co., Inc.

316 Pneumatic Sewage Ejector — Illustrated Bulletin S-50 describes a pneumatic or compressed air ejector developed to overcome and eliminate cleaning of screens and pumps, and discusses the ejector's advantages in terms of efficiency, economy and better sanitation. Operating principle is explained and illustrated by piping diagrams showing snap action air valve, electrode controls and float switch. The Blackburn-Smith Mfg. Co., Inc., Condenser Service and Engineering Co., Inc.

317 Flanges for Severe Service — This 4-pp bulletin describes a flange specially developed for services involving severe abrasion and corrosives, and for suction and discharge service. Goodall Rubber Co.

318 For Fine Diffusion — Bulletin 6530 describes company's Colaflex diffuser, a flexible collapsible unit for maintaining practically constant permeability for fine diffusion of air or gas in sewage and industrial waste treatment, water conditioning, absorption processes. Infilco Inc.

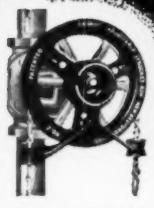
NEW HEAT SAVING EFFICIENCY

- *Longer Life*
- *Custom Molded Precision Pipe Fit*
- *Attractive, Smooth Finish*

Now available in pipe covering and block insulation, Mundet 85% Magnesia permits new heat-saving efficiency. Precision manufacturing on the latest type of automatic equipment insures uniform standards. Extra durability is built into the insulation. It does not "powder", settle or disintegrate. It is unaffected by either steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation. Write for specification information and recommendations. Mundet Cork Corporation, Insulation Division, 7115 Tonnelle Avenue, North Bergen, N. J.

MUNDET

MUNDET



Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

A range of 10 ADJUSTABLE sizes fits all valve wheels, with rising or non-rising stems, from 2 to 30 inches in diameter.

PREVENTS ACCIDENTS! No more climbing to operate overhead valves.

PREVENTS WASTE! Positive control, immediate response.

EASY CONTROL! Easier than direct manual operation.

SAVES MONEY! Avoids accidents, permits piping short-cuts, saves piping costs.

ADJUSTABLE . . . fits all valve wheels

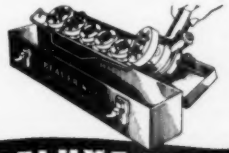
CUTS COSTS . . . simplifies pipe layouts

CUTS ACCIDENTS . . eliminates climbing

• Here's easy, convenient, instant control of overhead, out-of-reach valves — right from the floor! Four simple, quickly-assembled parts and the valve handwheel is ready to operate.

Distributors in principal cities, or send for Catalog Folder PE-2 and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Massachusetts



A DELUXE TOOL *with enclosed ratchet — for safety*

BEAVER NO. 3

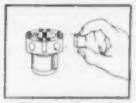
THREADS PIPE 1/8 TO 1 INCH
THREADS BOLTS 1/4 TO 1 INCH

• A world-wide favorite for 40 years. Ratchet teeth fully enclosed —for safety. Openings between dies for easy oiling and chip clearance. Dies square in shape—no weak sections. Can be inverted for close threading. Made right or left-hand. Dies available for conduit and brass tubing. Die head carrier, free. Metal case available, extra. Write for new catalog.

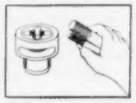
BEAVER PIPE TOOLS
274-300 DANA AVENUE • WARREN, OHIO, U. S. A.
"Over 50 Years of Friendly Service"

Oil and chip holes between dies.

Enclosed ratchet for safety.



Square shaped dies, no weak section.



Bolt dies available.

Handy carrier furnished free.

ADVERTISERS

Air Preheater Corp., Inc. *
Agency — G. M. Basford Company

Allis-Chalmers Mfg. Co. 16–17, 33, 103
Agency — Compton Advertising, Inc.

Allis-Chalmers Mfg. Co. (Tractor Div.) 91
Agency — Bert S. Gittins Advertising

American Chimney Corp. 150

American District Steam Company, Inc. *
Agency — Squier and Davis, Inc.

American Engineering Co. 12–13
Agency — Beatty and Oliver, Inc.

American Water Softener Co., The 89
Agency — Harris D. McKinney Organization

Ames Iron Works *
Agency — Melvin F. Hall, Inc.

Anderson, V. D. *
Agency — Will Inc.

Armstrong Machine Works 4
Agency — Russell T. Gray, Inc.

Atlas Valve Co. *
Agency — W. F. Schaphorst

Babbitt Steam Specialty Co. 147
Agency — Paul L. Kuch Advertising

Babcock & Wilcox Co., The 115
Agency — O. S. Tyson and Company, Inc.

Bailey Meter Company 130
Agency — Fuller & Smith & Ross, Inc.

Baldwin-Hill Co. 46
Agency — O. S. Tyson and Co., Inc.

Baltimore & Ohio RR *
Agency — Richard A. Foley, Inc.

Beaver Pipe Tools, Inc. 147
Agency — Meek and Thomas, Inc.

Belmont Packing & Rubber Co., The 150
Agency — McNevin-Wilson-Dalldorf, Inc.

Betz, W. H. & L. D. 87
Agency — The Harris D. McKinney Organization

Biddle Co., James G. 122
Agency — The Roland G. E. Ullman Organization, Inc.

Bird-Archer Co., The 109
Agency — Michel-Cather, Inc.

Bituminous Coal Institute 40–41
Agency — Benton & Bowles, Inc.

Blackburn-Smith Mfg. Co. 146

Bowser, Inc. 102
Agency — Willis S. Martin Company

Bridgeport Brass Co. 127
Agency — Hazard Advertising Company

Cambridge Instrument Co., The *
Agency — E. M. Freystadt Associates, Inc.

Chapman Valve Mfg. Co., The Inside Back Cover
Agency — Sutherland-Abbott

A. W. Chesterton Co. 138
Agency — W. Robert Robotham, Inc.

Cities Service Oil Co. 27
Agency — Ellington & Company, Inc.

Cleaver-Brooks Company 25
Agency — Klau-Van Pietersom-Dunlap Associates, Inc.

Cochrane Corporation *
Agency — Willard G. Myers Advertising Agency

Combustion Engineering-Superheater, Inc. 34–35
Agency — G. M. Basford Company

Condenser Service & Engineering Co., Inc. 141

Coppus Engineering Corporation 99
Agency — James Thomas Chirurg Company

Crane Co. 43
Agency — The Buchen Company

Darling Valve & Mfg. Co. *
Agency — Griswold-Eshleman Co.

Dart Union Co. 120
Agency — Sutherland-Abbott

Davis Engineering Corporation *
Agency — Thomas & Delehanty, Inc.

Davis Regulator Co. 144
Agency — Armstrong Advertising Agency

Dearborn Chemical Company 49
Agency — The Buchen Company

De Laval Separator Co., The 104
Agency — Donahue & Coe, Inc.

De Laval Steam Turbine Co. 123
Agency — Michel-Cather, Inc.

Detroit Stoker Company 121
Agency — Witte & Burden

Dowell Incorporated 39
Agency — MacManus, John & Adams, Inc.

Drew & Co., Inc., E. F. *
Agency — The Aitkin-Kynett Co.

Eastern Gas and Fuel Associates *
Agency — Ketchum, MacLeod & Grove, Inc.

Edward Valves, Inc. *
Agency — Marsteller, Gebardt & Reed, Inc.

Elliott Co. 2–3
Agency — Peterson & Kempner, Inc.

Ellison Draft Gage Co. *
Agency — Tri-State Advertising Co., Inc.

Engineer Co., The *
Agency — Michel-Cather, Inc.

Erie City Iron Works 112
Agency — Davies and McKinney

Everlasting Valve Co. *
Agency — Michel-Cather, Inc.

Flexitallic Gasket Company 45
Agency — William Jenkins Advertising

Foster Engineering Company 140
Agency — Sanger-Funnell, Incorporated

Foster Wheeler Corp. 28–29
Agency — Albert Frank-Guenther Law, Inc.

Fuller Company 145
Agency — O. S. Tyson and Company, Inc.

Garlock Packing Co., The *
Agency — Hutchins Advertising Company, Inc.

General Coal Company *
Agency — The Aitkin-Kynett Co.

General Electric Company 18
Agency — G. M. Basford Company

Gifford-Wood Co. 137
Agency — O. S. Tyson and Company, Inc.

Goodall Rubber Co., Inc. 142
Agency — George C. Taylor

Goulds Pumps 136
Agency — Charles L. Rumrill & Co., Inc.

Graver Water Conditioning Co. 135
Agency — Michel-Cather, Inc.

Green Fuel Economizer Co. 119
Agency — Sanger-Funnell, Incorporated

Grinnell Co., Inc. *
Agency — Horton-Noyes Company

Griscom-Russell Co., The *
Agency — Michel-Cather, Inc.

Gulf Oil Corp. 47
Agency — Young & Rubicam, Inc.

Hagan Corporation 101
Agency — Ketchum, MacLeod & Grove, Inc.

Hall Laboratories, Inc. 15
Agency — Ketchum, MacLeod & Grove, Inc.

Hays Corporation, The ..... *
Agency — Proebsting, Taylor, Inc.

Paul B. Huyette Co. 146

Infilco Incorporated 114
Agency — Ruthrauff & Ryan, Inc.

International Nickel Company, Inc., The 105
Agency — Marschalk & Pratt Co.

Johns-Manville 110
Agency — J. Walter Thompson Company

Johnson-March Corp. 143
Agency — Beaumont, Heller & Sperling, Inc.

Ladish Co. ..... *
Agency — The Cramer-Krasselt Co.

Lapp Insulator Co. 134
Agency — Ed. Wolff & Associates

Manning, Maxwell & Moore, Inc. 117
Agency — Fuller & Smith & Ross, Inc.

Marley Company, Inc., The ..... *
Agency — Valentine-Radford Advertising

Minneapolis-Honeywell Reg. Co. 30–31
Agency — The Aitkin-Kynett Co.

Mundet Cork Corp. 147
Agency — J. C. Bull, Inc.

National Airoil Burner Company, Inc. ..... *
Agency — R. E. Lovekin Corp.

National Aluminate Corporation 36
Agency — Armstrong Advertising Agency

National Business Papers ..... *

National Valve & Mfg. Co. ..... *

Niagara Blower Company ..... *
Agency — The Moss-Chase Company

Nicholson & Co., W. H. 144
Agency — Wilbur A. Myers

Northern Equipment Company 106
Agency — Davies and McKinney

Norton Company ..... *
Agency — James Thomas Chirurg Company

Ohio Injector Co. ..... *
Agency — Fuller & Smith & Ross, Inc.

Owens-Illinois Glass Co., Kaylo Div. 51
Agency — Canaday, Ewell & Thurber, Inc.

Pacific Pumps Inc. ..... *
Agency — The McCarty Co.

Permutit Co., The ..... *
Agency — Cunningham & Walsh, Inc.

Pipe and Tubular Products 113
Agency — Robert S. Kampmann, Jr. Advertising

Powell Co., The Wm. 95
Agency — Associated Advertising Agency, Inc.

J. F. Pritchard (Equip. Div.) ..... *
Agency — Carter Advertising Agency

% Proportioneers, Inc. % 6
Agency — Hammond-Goff Co.

Ramtite Co. ..... *
Agency — Marstellar, Gebhardt and Reed, Inc.

Raybestos — Manhattan, Inc. 97
Agency — Gray & Rogers

Reliance Gauge Column Company 129
Agency — Carr Liggett Advertising, Inc.

Republic Flow Meters Co. 92–93
Agency — Glenn, Jordan, Stoetzel, Inc.

Republic Rubber Division ..... *
Agency — Meek and Thomas, Inc.

Revere Copper and Brass Inc. 24
Agency — St. Georges & Keyes, Inc.

Richardson Scale Co. 116
Agency — O. S. Tyson and Company, Inc.

Riley Stoker Corporation ..... *
Agency — The Davis Press, Inc.

Roto Div. of Elliott Co. 124
Agency — Jos. S. Vogel & Co.

Milton Roy Co. ..... *
Agency — Harris D. McKinney

R-P & C Valve Division, American Chain & Cable 132
Agency — Reincke, Meyer & Finn

R-S Products Corporation 128
Agency — Carl M. Craig Agency

Scovill Mfg. Co. 98
Agency — James Thomas Chirurg Company

Sinclair Refining Co. 52–53
Agency — Morey, Humm & Johnstone, Inc.

Standard Oil Co. (Indiana) 21
Agency — McCann-Erickson, Inc.

Stone & Webster Engineering Corporation 100
Agency — Harold Cabot & Co., Inc.

Sun Oil Company 9
Agency — Gray & Rogers

Swartwout Company, The ..... *
Agency — Palm & Patterson

Taylor & Co., W. A. ..... *
Agency — Emery Advertising Corporation

Terry Steam Turbine Co., The 139
Agency — Gassaway, Mark & Co.

Texas Co., The ..... Back Cover
Agency — Erwin, Wasey & Company, Inc.

Tube Turns Inc. 19, 20
Agency — Griswold Eshleman Co.

United States Rubber Company 107
Agency — Fletcher D. Richards, Inc.

Vaco Products Co. ..... *
Agency — Kenclffe, Breslich & Co.

Vogt Machine Co., Henry 108
Agency — Farson & Huff

Vulcan Soot Blower Division, Continental Foundry & Machine Company ..... *
Agency — Davies and McKinney

Wallace & Tiernan Products, Inc. 126
Agency — Branstater Associates, Inc.

Warren Steam Pump Co., Inc. 96
Agency — The Davis Press, Inc.

Watson-Stillman Co. ..... *
Agency — McNevin-Wilson-Dalldorf, Inc.

Western Chemical Company 131
Agency — Carter Advertising Agency, Inc.

Western Precipitation Corp. 32
Agency — Dozier, Eastman & Co.

Westinghouse Electric Corporation 22–23, 118, 125
Agency — Fuller & Smith & Ross, Inc.

Wheeler Mfg. Co., C. H. ..... *
Agency — The Roland G. E. Ullman Organization, Inc.

Wickes Boiler Co., The 111
Agency — Price, Hedrick & Tanner, Inc.

Wilson, Inc., Thomas C. ..... *
Agency — Michel-Cather, Inc.

Wing Mfg. Co., L. J. 143
Agency — Willard G. Myers Advertising Agency

Worthington Pump & Machinery Corp. 14, 26, 94, 133
Agency — James Thomas Chirurg Company

Wright Chemical Co. ..... *
Agency — Schnell & Associates

Yarnall-Waring Company 10–11, 54
Agency — Michener & Holland

Zimmerman ..... *
Agency — Wilson Advertising

Firms whose advertising is not in this issue but is appearing in other issues are marked with an *

BELMONT PACKINGS
for WATER...STEAM...OIL...

BELMONT V . . . for oil hydraulic services from low pressures to extremely heavy duty, hot and cold water.
BELMONT 30 . . . for high pressure steam rods, expansion joints, air, and gas.
BELMONT 19 . . . for hot and cold water rods and plungers; low and intermediate steam rods.

for better sealing—LONGER

Regardless of the temperatures or pressures involved . . . no matter what the lading . . . *your* equipment maintenance costs can benefit from longer, more dependable packing life. If you're *paying* for the best—and you probably are—make sure you *get* it by specifying BELMONT Packings in formulations suited to your particular needs.

Don't make do with the next best—*insist* on BELMONT . . . available in a wide range of materials . . . hundreds of styles and types . . . through distributors everywhere.

For technical assistance on packing specifications, write direct—ask for Catalog #40 or detail your particular problems. 4-M-1A

for Steam • Water • Oil • Gas • Air
Acids • Alkalies • Ammonia

THE
BELMONT
PACKING AND RUBBER CO.
Butler and Sepviva Streets
Philadelphia 37, Pennsylvania

Rings • Spirals • Coils • Reels
Spools • Sheets • Gaskets
There's a Belmont Packing for every service

CLASSIFIED ADVERTISING

EQUIPMENT FOR SALE

300 KW PORTABLE MOTOR GENERATOR SET
Motor Synchronous, 450 horsepower
2300, 4160, 6400 volts
60 cycles, RPM 900
Generator Output — 120-240 DC volts
3 wire with self-contained filter system
For further information contact D. J. Titus, 10521 Whipple St., North Hollywood, Calif.

Complete POWER PLANT

CONSISTING OF THE FOLLOWING:

3 Uni-Flow Ridgeway engines direct connected to D.C. generators
1 200 KW 123-246 volts D.C.
2 400 KW 123-246 volts D.C.
3 420 H.P. Union Erie water tube boilers, equipped with Riley stokers.
1 1000-lb weighing lorry
2 Union boiler feed steam pumps
3 27-inch fans for forced draft for boilers
3 9000 gallons — Filter Tanks.

Above Equipment Can Be Sold in Total or in Part

MASONIC TEMPLE ASSOCIATION
500 Temple Avenue Detroit 1, Michigan

HELP WANTED

Insurance Engineering —
BOILERS
Career for graduates of approved engineering college or nautical schools; over 27 yrs. of age and having a minimum of 5 yrs. practical experience in marine or stationary power plants. Must have at least a 1st assistant's marine engineering license or equivalent stationary engineer license. Give us brief outline of education and experience. Box 1666 POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Illinois.

WANTED
MECHANICAL ENGINEER
Experienced mechanical engineer with steam background capable of engineering, selecting equipment and designing steam plant, auxiliaries and distribution system. Electrical experience also desirable. Location, south. Write complete qualifications in first letter, including references and salary desired. Details confidential. Box 1667, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Illinois.

POSITION WANTED

POWER ENGINEERING CONSULTANT AVAILABLE
Retired Engineer with 42 years of most practical experience as chief engineer of well-known Middle West utility company will accept consulting assignments. Has done much work in field of handling and burning low rank bituminous coal and lignite, centralized control of power plants, general power plant operation. Fellow ASME, Fellow AIEE. Box 1665, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Ill.

GAGE GLASSES AND
High Pressure Rubber Gaskets
ALL SIZES TO FIT YOUR WATER GAGES

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

Consult Us For:
CHIMNEYS . . .
FURNACE WORK . . .
BOILER SETTINGS

AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES:
BOSTON • PHILADELPHIA • CLEVELAND
DETROIT • RICHMOND, VA. • RALEIGH, N. C.

Sign Your
DECLARATION OF INDEPENDENCE
☆
Buy U. S. Savings Bonds!

...as much as 65% to 80%
BY
CHAPMAN
Tilting Disc CHECK VALVES

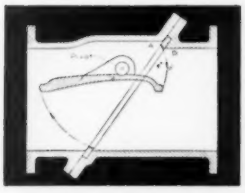
Typical test on a 22-inch Chapman Tilting Disc Check Valve under 450 pounds gas pressure . . . carrying 3,200,000 feet of gas per hour . . . showed a drop in pressure of less than 7 inches of water.

The average reduction of head loss . . . as against conventional check valves . . . is 65% to 80%.

That's because the balanced hinge-pinned disc, of special aerofoil design, has exceptional lifting qualities, lightness in unbalanced weight, and minimum resistance to flow in open position. And valve body is streamlined, with through-way always equal to the area of the pipe.

This means that *disc won't slam* under usual piping arrangements ...and that it seats drop-tight. It means, too, that many new lines can be designed in smaller size. Send for Catalog No. 30, giving complete data and test-curves on Chapman Tilting Disc Check Valves.

THE CHAPMAN VALVE MFG. CO
INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting-Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

TURBINE OIL STILL GOOD AS NEW AFTER 34,498 HOURS OPERATION...

TEXACO REGAL OIL (R&O) keeps Kentucky Utilities Company turbines "on the line"

"We have used *Texaco Regal Oil (R&O)* with perfect results and not a single difficulty," says Mr. Bryan Bunch of Kentucky Utilities Company, Tyrone, Ky. "The oil has never been changed since turbines were installed and recent tests show it to be as good as new."

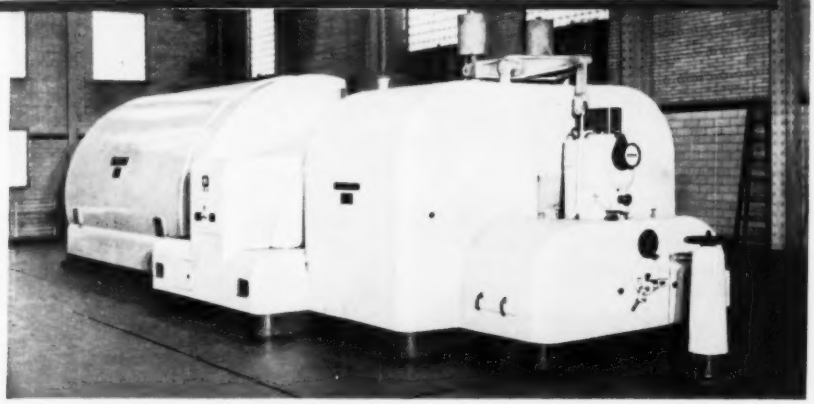
Kentucky Utilities has two 25,000 KW turbines. No. 1 has been operated for 34,498 hours, No. 2 for 28,547 hours. Both run most of the time at full load, occasionally are overloaded.

Ability of *Texaco Regal Oil (R&O)* to stand up under severe load conditions and keep turbines free of rust, sludge and foam, springs from the fine quality of the base stocks used. These are carefully refined, fortified with special Texaco additives and specially processed to make them *more than ten times as oxidation-resistant* as ordinary turbine-quality oils and vastly more resistant to rust and foaming.

There is a complete line of *Texaco Regal Oils (R&O)*, all designed to give your turbines extra protection throughout an extra long service life. They more than meet the stringent requirements of all leading turbine builders.

Let a Texaco Lubrication Engineer show you in detail the cost-saving advantages of Texaco lubrication. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.



TEXACO Regal Oils (R&O)

FOR ALL TURBINES

Faithfully yours 50 *for Fifty Years*

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. METROPOLITAN OPERA radio broadcasts every Saturday afternoon.